

**FINAL REPORT**  
**January 2002**

**REPORT NO. 01-16**



**M871A3 TACTICAL TRAILER**  
**22.5-TON PAYLOAD CAPACITY**  
**TP-94-01,**  
**“TRANSPORTABILITY TESTING PROCEDURES”**

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**REPORT NO. 01-16**

**January 2002**

**M871A3 TACTICAL TRAILER**

**TP-94-01, "TRANSPORTABILITY TESTING PROCEDURES"**

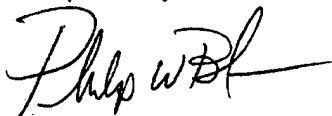
**ABSTRACT**

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division, (SOSAC-DEV), was tasked by the Program Manager, Medium Tactical Vehicles to conduct transportability testing on the M871A3 Tactical Trailer, 22.5-Ton Payload Capacity. The M871A3 was tested in accordance with TP-94-01, "Transportability Testing Procedures." Based on our review and testing, the M871A3 trailer, as designed and tested, is adequate but not ideal for transport of ammunition.

The following items were discovered during initial evaluation and testing of the M871A3 trailer:

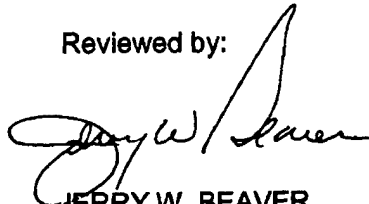
- a. Tie-down anchor ring spacing (longitudinal) - Current spacing is 24 inches center to center. This spacing creates situations where only 1 strap per row of pallets can be used to secure the load to the trailer. Recommended spacing is 18 inches.
- b. Tie-down anchor ring spacing (lateral) - Current lateral spacing is 79 inches, side to side. This spacing makes securing many two-pallet-wide and three-pallet-wide loads difficult or impossible, since load widths can be near trailer width or approximately 96 inches wide.
- c. Recessed deck channel - The trailer has a full-length recessed channel on each side that allows for mounting of the tie-down rings so that they are flat and flush with the trailer deck. This open channel will preclude many pallet units from being positioned properly on the trailer, will cause damage to the pallets, and/or inhibit the proper securement of the load. Recommend that the area between the rings be filled in or that the full-length recessed channel be eliminated.
- d. Side panel stake storage area. The rear panel where the stakes are stored bowed outward during transport. This allowed the stakes to become wedged in the bottom of the storage area. Recommend that the securement provisions on the rear panel be changed to prevent this from occurring in the future.

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VALIDATION ENGINEERING DIVISION  
MCALESTER, OK 74501-9053

REPORT NO. 01-16

**M871 Tactical Trailer, 22.5-Ton Payload Capacity  
TP-94-01, "Transportability Testing Procedures"**

TABLE OF CONTENTS/

PART  
PAGE NO.

1. INTRODUCTION .....	1-1
A. BACKGROUND.....	1-1
B. AUTHORITY.....	1-1
C. OBJECTIVE .....	1-1
D. CONCLUSION .....	1-1
2. ATTENDEES.....	2-1
3. TEST EQUIPMENT.....	3-1
4. TEST PROCEDURES .....	4-1
A. RAIL IMPACT TEST METHOD .....	4-1
B. HAZARD COURSE .....	4-3
C. ROAD TRIP .....	4-4
D. PANIC STOPS .....	4-4
E. WASHBOARD COURSE .....	4-4
5. TEST RESULTS .....	5-1
5.1 M871A3 Trailer w/11,859 POUNDS PAYLOAD .....	5-1
A. RAIL IMPACT .....	5-1
B. HAZARD COURSE .....	5-4
C. ROAD TRIP .....	5-4
D. PANIC STOPS .....	5-4
E. WASHBOARD .....	5-5
5.2 M871A3 Trailer w/45,180 POUNDS PAYLOAD .....	5-5
A. RAIL IMPACT .....	5-5
B. HAZARD COURSE .....	5-8
C. ROAD TRIP .....	5-8
D. PANIC STOPS .....	5-8
E. WASHBOARD .....	5-8
F. RAIL IMPACT (RETEST) .....	5-9

5.3 M871A3 TRAILER W/33,940-POUND PAYLOAD .....	5-12
A. RAIL IMPACT .....	5-13
B. HAZARD COURSE .....	5-16
C. ROAD TRIP .....	5-17
D. PANIC STOPS .....	5-17
E. WASHBOARD .....	5-17
5.4 M871A3 TRAILER W/45,180-POUND PAYLOAD .....	5-18
A. RAIL IMPACT .....	5-19
6. ACCELEROMETER DATA .....	6-1
7. DRAWINGS .....	7-1

## **PART 1 – INTRODUCTION**

**A. BACKGROUND.** The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SOSAC-DEV), was tasked by the Program Manager, Medium Tactical Trailers to conduct transportability testing on the M871A3 Tactical Trailer. The trailer was manufactured by Fontaine Trailer in Princeton, Kentucky. The trailer was tested in accordance with TP-94-01, "Transportability Testing Procedures."

**B. AUTHORITY.** This test was conducted IAW mission responsibilities delegated by the U.S. Army Operations Support Command (OSC), Rock Island, IL. Reference is made to the following:

1. AR 740-1, 15 June 2001, Storage and Supply Activity Operation.
2. IOC-R, 10-23, Mission and Major Functions of USADAC, 7 January 1998.

**C. OBJECTIVE.** The objective of the testing was to determine if the M871A3 trailer was adequate to transport ammunition by road and rail. The trailer was rail impact tested using both a Trailer-on-Flatcar (TOFC) railcar and a flatcar with chains. The test loads included; intermodal end opening container with MLRS Pods, intermodal end opening container with 155MM Separate Loading Projectiles (SLPs), and a breakbulk cargo load with 155MM SLPs and 105MM boxed ammunition.

**D. CONCLUSION.** Based on our review and testing, the M871A3 trailer, as designed and tested, is adequate but not ideal for transport of ammunition. Several recommendations for improvements were discovered during evaluations and are listed in the Abstract.

## **PART 2 - ATTENDEES**

DATE PERFORMED: 29 October – 8 November 2001

### **ATTENDEE**

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### **PART 3 - TEST EQUIPMENT**

1. Semi-trailer, Low bed, 22.5 tons

Model: M871A3

Manufactured by Fontaine Trailer Company, Princeton, Kentucky,

Date of Manufacture: 08/2001

VIN: 13N-2412A-X-15996058

Gross Vehicle Weight Rating: 61,700 pounds

Empty Weight: 17,500 pounds

Length: 41 feet 3 inches

Width: 96 inches

2. Truck, Tractor

Model: M1088

Serial #: T-011181BDKG

NSN: 2320-01-355-4332

Weight: 19,160 pounds

Length: 281 inches

Width: 96 inches

Height: 112 inches

3. Trailer-on-Flatcar

CNW 780784

Built: 11/71

LT WT: 46,700 pounds

LD LMT: 70,000 pounds

Length: 50.5 feet



4. Trailer-on-Flatcar (TOFC) Railcar  
CNW 780576  
Built: 07/75  
LT WT: 46,200 pounds  
LD LMT: 70,000 pounds  
Length: 50.5 feet
  
5. Flatcar  
ITTX 972861  
Built: 06/70  
LT WT: 78,000 pounds  
LD LMT: 142,000 pounds  
Length: 89.3 feet  
Equipped with 56 Chains  
Chain size: 0.5 inch  
Working Load Limit: 13,750 pounds  
Minimum Breaking Load Limit: 55,000 pounds
  
6. Intermodal Container with MLRS Pods  
Date of Manufacture: 02/90  
Manufacturer: J.D. Bertolini  
ID # USAG 060657 9  
Maximum Gross Weight: 44,800 pounds  
Tare Weight: 5,000 pounds
  
7. Intermodal Container with Separate Loading Projectiles  
Date of Manufacture: 12/96  
Manufacturer: Siam Cargo Container Company, Ltd.  
ID # MLCU 321109 0  
Maximum Gross Weight: 67,200 pounds  
Tare Weight: 4,850 pounds

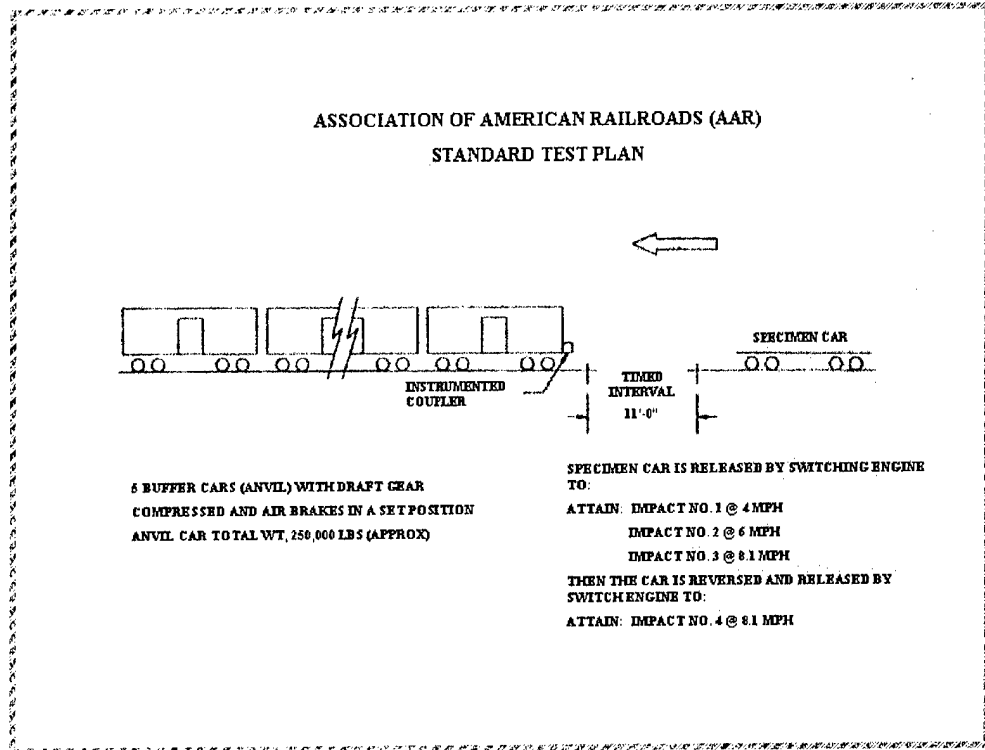
## **PART 4 - TEST PROCEDURES**

The test procedures outlined in this section were extracted from TP-94-01, "Transportability Testing Procedures," July 1994, for validating tactical vehicles and outloading procedures used for shipping munitions by tactical truck and railcar.

Inert (non-explosive) items were used to build the loads. The breakbulk test load (see Part 5.4) was prepared using the blocking and bracing procedures proposed for use with munitions (**see Part 7 for procedures**). The procedures were used as a guideline and the tiedown procedures were adjusted to accommodate the tiedown ring spacing and locations on the M871A3 trailer. The weight and physical characteristics (weights, physical dimensions, center of gravity, etc.) of the test loads were similar to live (explosive) ammunition.

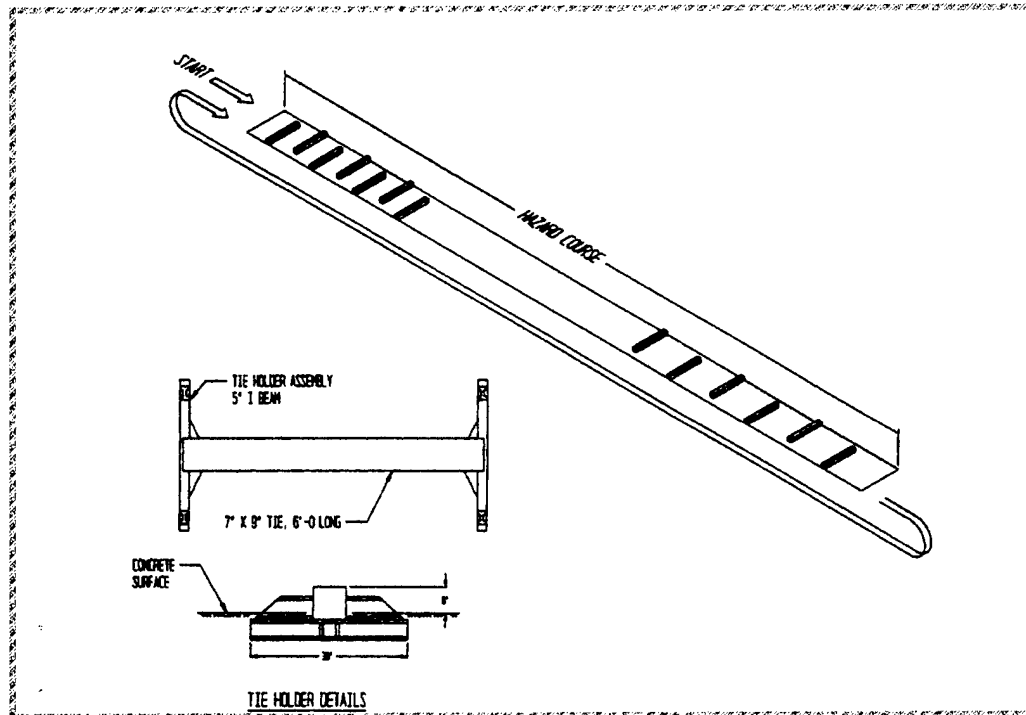
**A. RAIL IMPACT TEST METHOD.** The loaded M871A3 trailer was secured to a conventional friction draft gear non-cushioned TOFC railcar with cushioned stanchion or chain-equipped flatcar. Three chains were used per tie-down ring to secure the trailer to the flatcar. MTMCTEA Pamphlet 55-19 was used as a general guide to build the wooden stanchion required to support the trailer during testing on the chain equipped flatcar. Modifications were required to the MTMCTEA Pamphlet design due to the trailer kingpin height. Equipment needed to perform the test included the specimen (hammer) car, four empty railroad cars connected together to serve as the anvil, and a railroad locomotive. The anvil cars were positioned on a level section of track with air and hand brakes set and with draft gears compressed. The locomotive unit pushed the specimen car toward the anvil at a predetermined speed, then disconnected from the specimen car approximately 50 yards away from the anvil cars allowing the specimen car to roll freely along the track until it struck the anvil. This constituted an impact. Impacting was accomplished at speeds of 4, 6, and 8.1 mph in one direction and at a speed of 8.1 mph in the reverse direction. Tolerances for the impact speeds are plus .5 mph and minus zero mph. The impact speeds were determined by

using an electronic counter to measure the time for the specimen car to traverse an 11-foot distance immediately prior to contact with the anvil cars (see Figure 1).



**Figure 1. Rail Impact Sketch**

**B. HAZARD COURSE.** The loaded M871A3 trailer was transported over the 200-foot-long segment of concrete-paved road consisting of two series of railroad ties projecting 6 inches above the level of the road surface. The hazard course was traversed two times (see Figure 2).



**Figure 2. Hazard Course Sketch**

1. The first series of ties are spaced on 10-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.
  2. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.
  3. The second series of ties are spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.
- The test load is driven across the hazard course at speeds that would produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

C. **ROAD TRIP.** The loaded M871A3 trailer was transported for a distance of 35 miles over a combination of roads surfaced with gravel, concrete and asphalt. The test route included curves, corners, railroad crossings and stops and starts. The trailers traveled at the maximum speed for the particular road being traversed, except as limited by legal restrictions.

D. **PANIC STOPS.** This testing was not required since the M871A3 trailer was rail impact tested.

E. **WASHBOARD COURSE.** The loaded M871A3 trailer was driven over the washboard course at a speed that produced the most violent response in the vehicles.

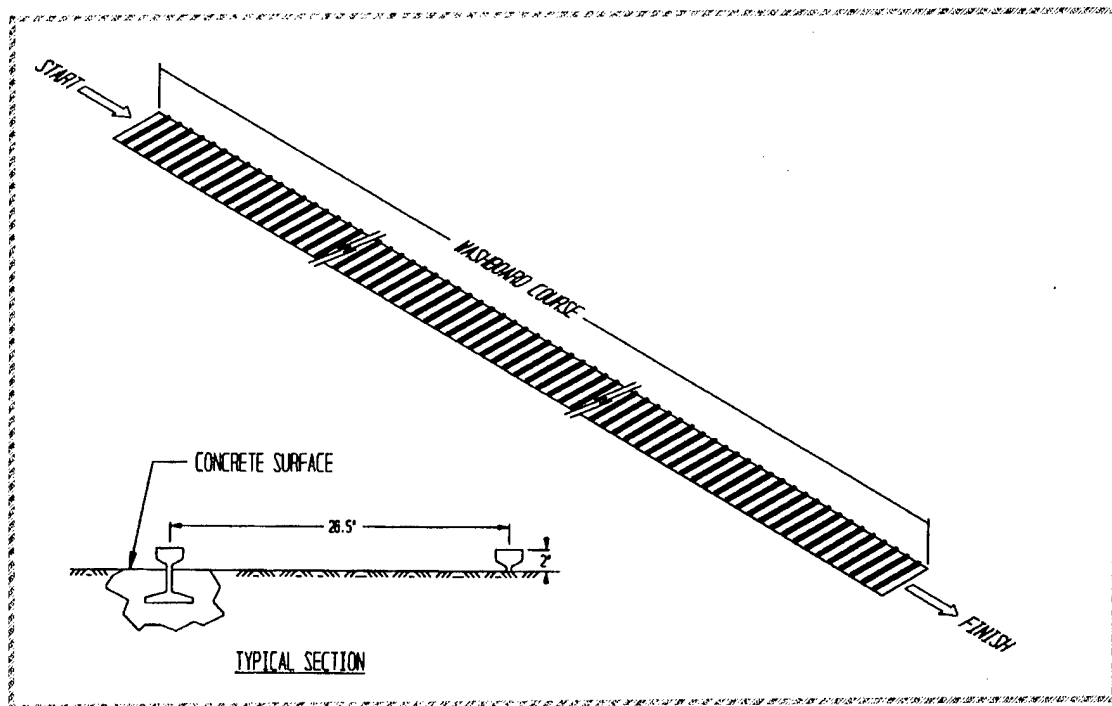


Figure 3. Washboard Course Sketch

## **PART 5 – TEST RESULTS**

### **5.1 Test Specimen: M871A3 Trailer**

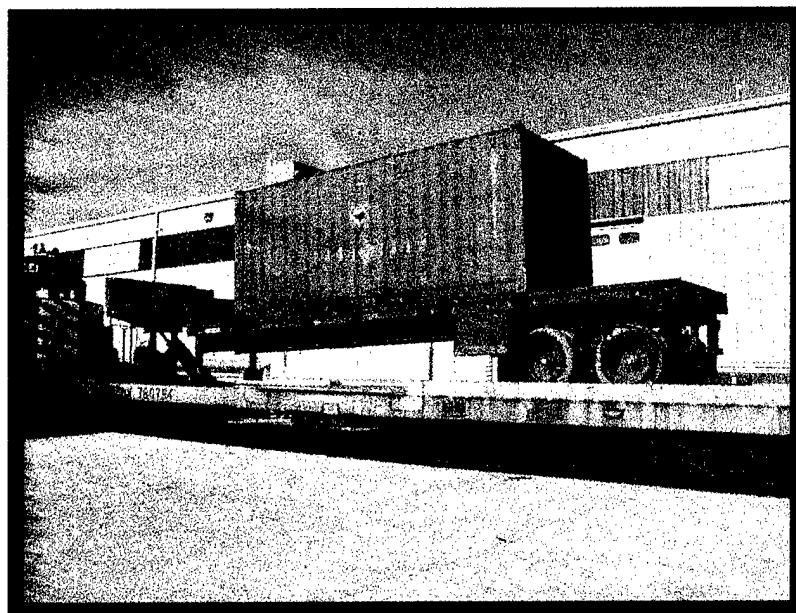
Manufacturer: Fontaine Trailers

Payload: Intermodal container with MLRS Pods

Gross Weight: 11, 859 pounds

Testing Date: 29-31 October 2001

#### **A. RAIL IMPACT.**



**Photo 1: Trailer-on-Flatcar Rail Impact Testing of M871A3 Trailer**

DESCRIPTION	WEIGHT
Flatcar Number: CNW 780784	46,700 lbs.
ISO Container with MLRS Pods	11,859 lbs.
M871A3 Trailer	17,640 lbs.
Total Specimen Wt.	76,199 lbs.
Buffer Car (four cars)	250,000 lbs.

Figure 4

IMPACT NUMBER	AVERAGE VELOCITY (MPH)
1	4.0
2	6.4
3	8.1
4	7.9

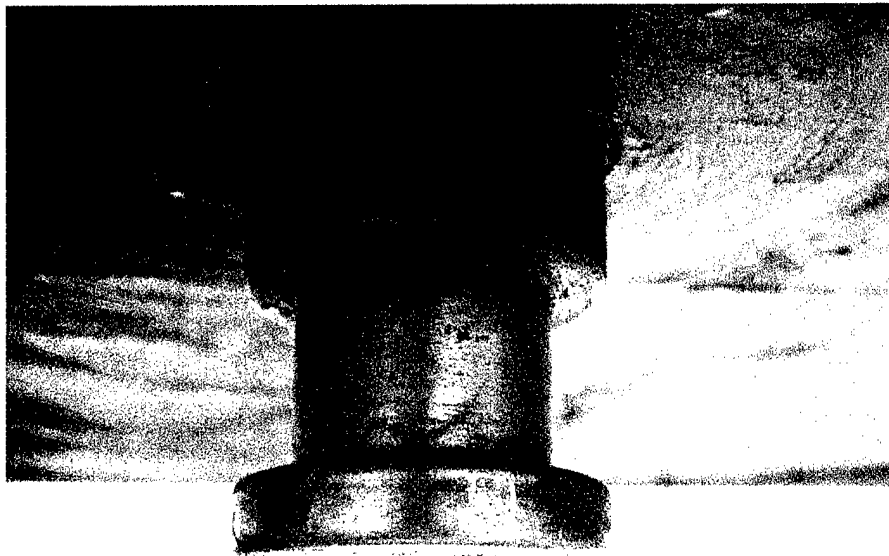
Figure 5

**Remarks:**

1. No damage or excessive movement occurred with the trailer, container or twistlocks during testing.
2. The test times for impacts 1-3 were obtained using a stopwatch. For impact 4 an electronic speed sensor was used.
3. Impacts 1-3 were conducted with the rear of the trailer in the direction of impact. Impact 4 was with the trailer front in the direction of impact.
4. The trailer was inspected following the removal from the railcar. The kingpin had sustained some galling or flattening damage during the rail impact testing. This was due to the railcar stanchion locking plates had some wear which

prevented secure engagement against the trailer kingpin. The trailer was mission capable and testing continued.

5. Impact No. 4 was not repeated to obtain average velocity of 8.1 MPH due to additional rail impact testing scheduled on the TOFC with trailer at full payload .



**Photo 2:** Galling on the kingpin



**Photo 3**



**B. HAZARD COURSE.**

Date of Testing: 31 October 2001

PASS NO.	ELAPSED TIME	AVERAGE VELOCITY (MPH)
1	27 Seconds	5.7
2	26 Seconds	5.9
3	27 Seconds	5.7
4	27 Seconds	5.7

**Figure 6**

**Remarks:** No damage or excessive movement occurred with the trailer, container or the twistlocks during testing. The trailer and load were inspected following each pass. The velocity data represents the average velocity.

**C. ROAD TRIP.** No damage or excessive movement occurred with the trailer, container or twistlocks during testing.

**D. PANIC STOPS.** Testing was not required since the M871A3 was rail impact tested.

**E. WASHBOARD.** No damage or excessive movement occurred with the trailer, container or twistlocks during testing.

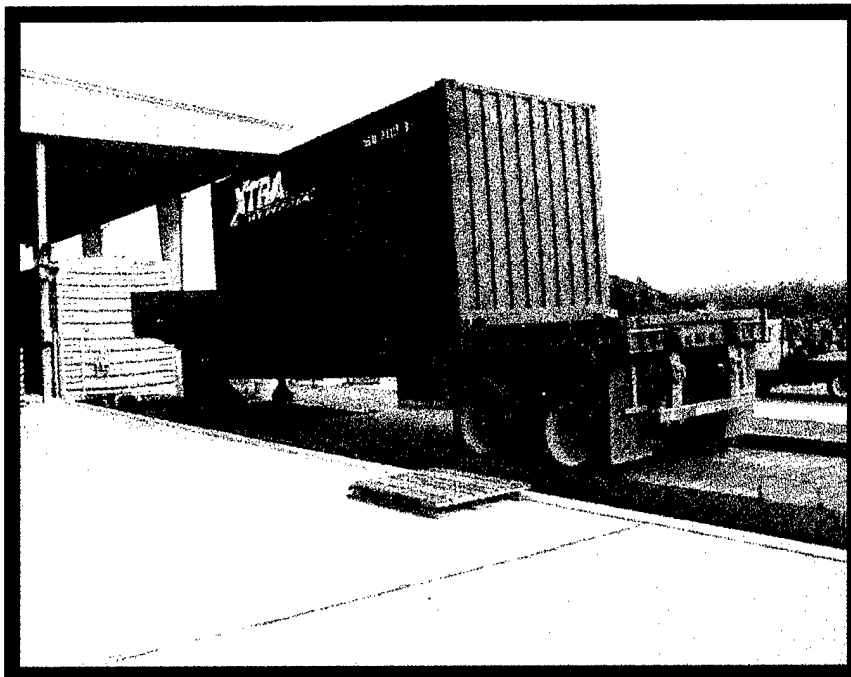
**5.2 Test Specimen: M871A3 Trailer**  
Manufacturer: Fontaine Trailers

Payload: Intermodal container with 155MM Separate Loading Projectiles.  
In addition, one pallet of MK-82, 500-pound bombs was secured against the trailer bulkhead.

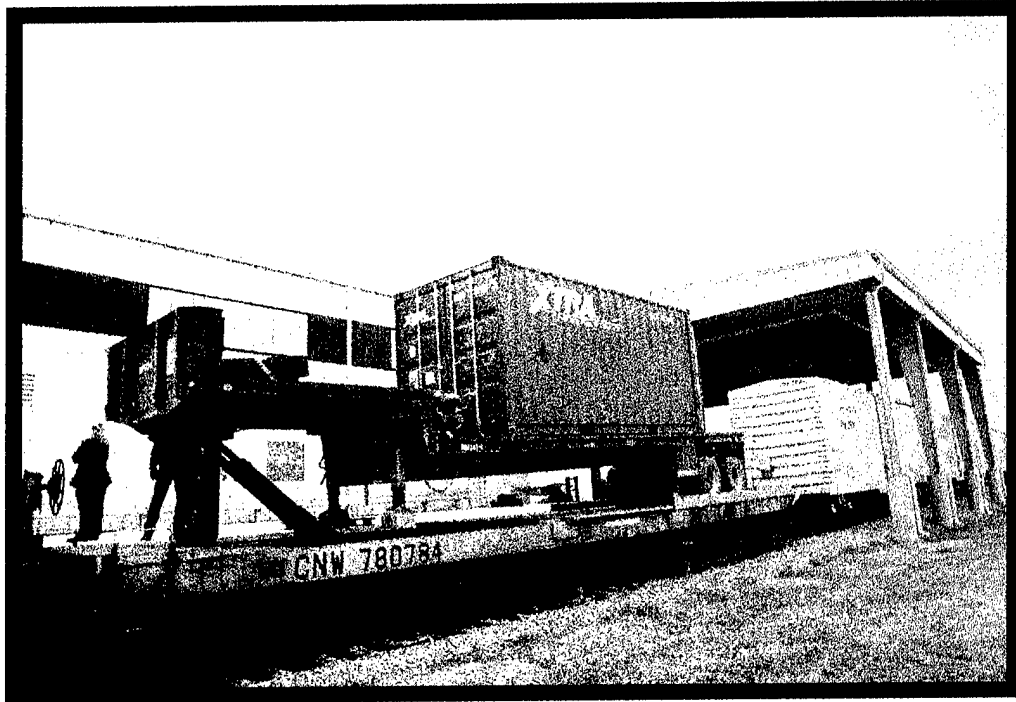
Gross Weight: 45,180 pounds  
42,180 pounds (container and 155MM SLPs) plus 3,000 pounds for the MK-82 bomb pallet.

Testing Date: 1 November 2001

**A. RAIL IMPACT.**



**Photo 4: Trailer-on-Flatcar Rail Impact Testing of M871A3  
Trailer at Full Payload**



**Photo 5: Trailer on Flatcar Rail Impact Testing of M871A3 Trailer at Full Payload**

DESCRIPTION	WEIGHT
Flatcar Number: CNW 780784	46,700 lbs.
ISO container with 155MM SLPs and additional MK-82 pallet of 500# bombs	45,180 lbs.
M871A3 Trailer	17,640 lbs.
Total Specimen Wt.	109,520 lbs.
Buffer Car (four cars)	250,000 lbs.

**Figure 7**

IMPACT NUMBER	AVERAGE VELOCITY (MPH)
1	3.7
2	4.3
3	6.2
4	8.2
5	See 3 of Remarks

Figure 8

**Remarks:**

1. The brake on the railcar did not fully release on Impact 1. The rail crew corrected the problem and testing continued.
2. Following Impact 4 the twistlock at the door end of the container, driver's side, jammed and would not turn freely. No damage was found on the twistlock or container corner casting. The problem occurred due to the tolerances between the twist lock and the deck opening. This allowed the twistlock to be pushed up and caused it to jam. This did not affect offloading of the container.
3. The reverse 8 mph impact was not performed. Inspection of the area around the stanchion kingpin locking plate revealed a gap of 0.50 to 0.75 inches. This gap was deemed to be excessive and rail impact testing was discontinued until an acceptable flatcar was provided by the rail carrier. The rail impact retest results are shown in "F" of this section.
4. The trailer was offloaded from the railcar in preparation for the Hazard Course Testing.
5. Impacts 1-4 were conducted with the rear of the trailer facing the direction of impact.
6. No damage or excessive movement occurred with the trailer, container, or twistlocks during testing.
7. The velocity data represents the average speed during the test.

**B. HAZARD COURSE.**

PASS NO.	ELAPSED TIME	AVERAGE VELOCITY (MPH)
1	31 Seconds	5.0
2	26 Seconds	5.9
3	26 Seconds	5.9
4	23 Seconds	6.2

**Figure 9**

**Remarks:**

1. No damage or excessive movement occurred with the trailer, container, or twistlocks during testing. The trailer and load were inspected following each pass.
2. Following Pass #4 the twistlock at the non-door end of the container, driver's side, jammed and would not turn freely. No damage was found on the twistlock or container corner casting. This problem occurred due to the tolerances between the twistlock and the deck opening. This enabled the twistlock to be pushed up and caused it to jam. This did not affect the offloading of the container.
3. The velocity data represents the average speed during the test.

**C. ROAD TRIP.** No damage or excessive movement occurred with the trailer, container, or twistlocks during testing.

**D. PANIC STOPS.** Testing was not required since the M871A3 was rail impact tested.

**E. WASHBOARD.** No damage or excessive movement occurred with the trailer, container or twistlocks during testing.

#### **F. RAIL IMPACT (RETEST).**

Payload: Intermodal container with 155MM Separate Loading Projectiles.  
In addition, one pallet of MK-82, 500-pound bombs was secured against the bulkhead of the trailer.

Gross Weight: 45,180 pounds

42,180 pounds (container and 155MM SLPs) plus 3,000 pounds for the MK-82 bomb pallet.

Testing Date: 8 November 2001



**Photo 6: Trailer-on-Flatcar Rail Impact Testing of M871A3 Trailer at Full Payload**

DESCRIPTION	WEIGHT
Flatcar Number: CNW 780576	46,200 lbs.
ISO container with 155MM SLPs and additional MK-82 pallet of 500# bombs	45,180 lbs.
M871A3 Trailer	17,640 lbs.
Total Specimen Wt.	109,020 lbs.
Buffer Car (four cars)	250,000 lbs.

Figure 10

IMPACT NUMBER	AVERAGE VELOCITY (MPH)
1	3.7
2	4.5
3	6.0
4	8.4
5	8.3

Figure 11

**Remarks:**

1. Following Impact 2, the twistlock at the door end of the container, driver's side, jammed and would not turn freely. The reason has been explained previously. This did not affect offloading of the container. The twistlock jammed following the reverse impact.
2. The container moved 0.375 inches following the reverse impact.

3. Impacts 1-4 were conducted with the rear of the trailer facing the direction of impact. Impact No. 1 was low average velocity due to improper brake release on the specimen flatcar. Impact 5 was conducted with the front of the trailer facing the direction of impact.
4. No damage or excessive movement occurred with the trailer, container or twistlocks during testing.
5. The velocity data represents the average speed during the test.



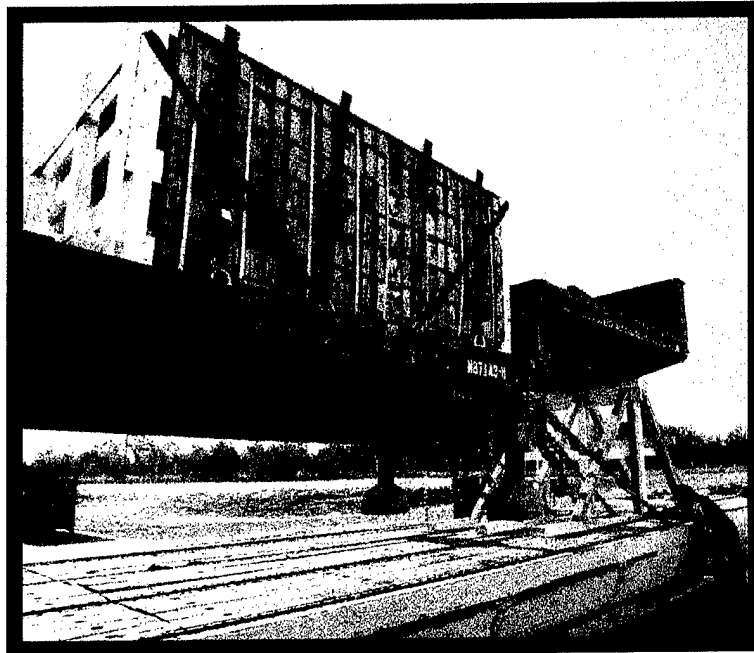
5.3. Test Specimen: M871A3 Trailer

Manufacturer: Fontaine Trailers

Payload: Breakbulk load with pallets of 155MM SLPs and pallets of 105MM boxed ammunition

Gross Weight: 33,940 pounds

Testing Date: 6 November 2001

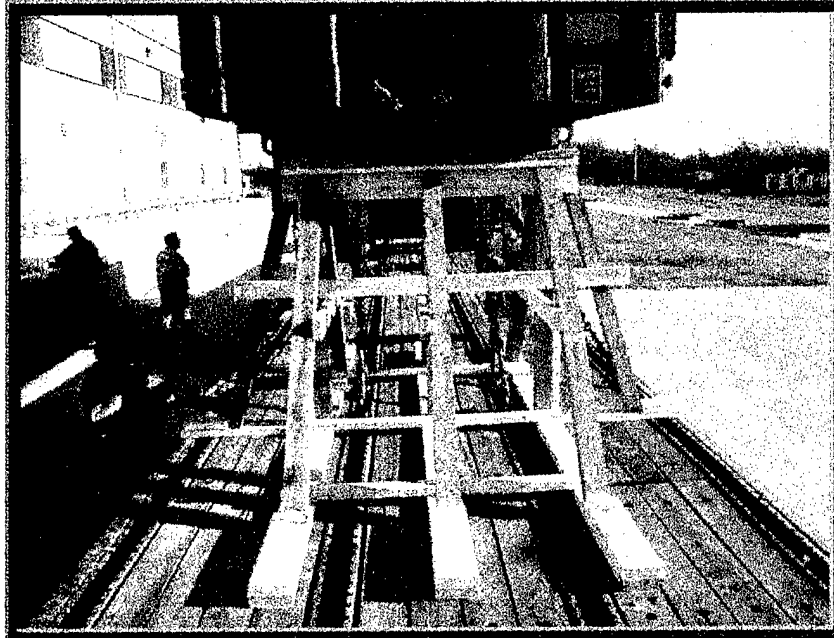


**Photo 7: Breakbulk Load on M871A3 Trailer**

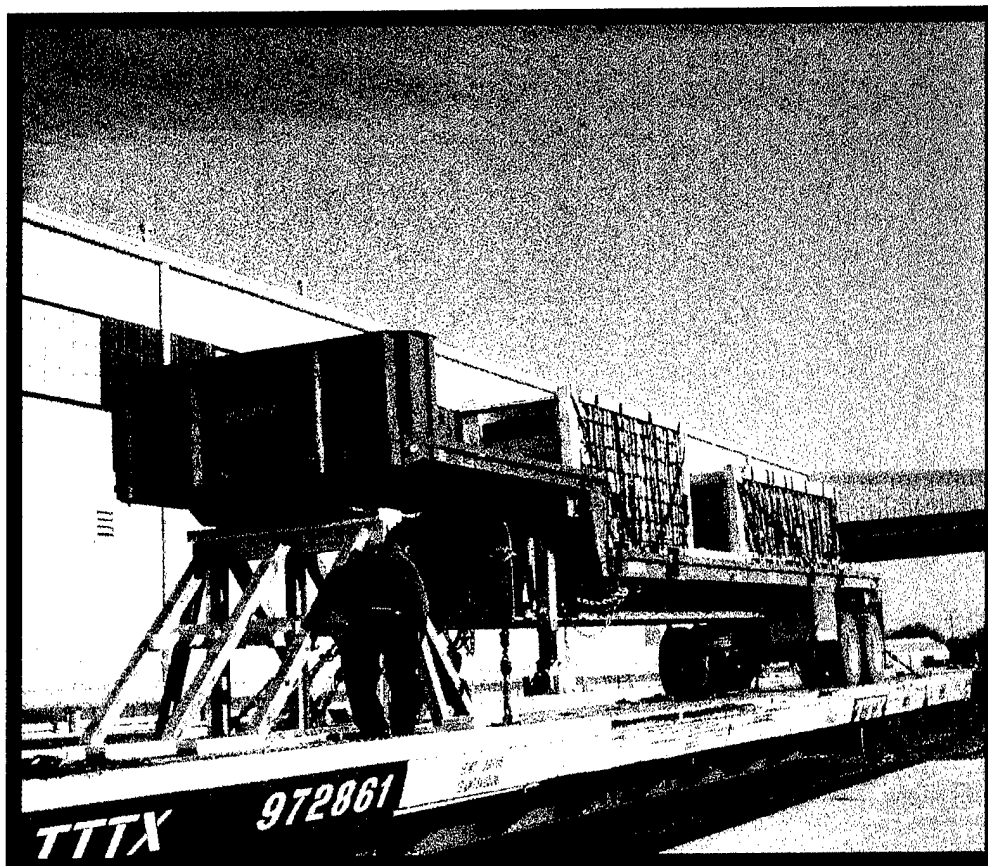


**Photo 8: M871A3 Trailer with Breakbulk Cargo on Flatcar**

**A. RAIL IMPACT.**



**Photo 9: Wood Stanchion Used During Breakbulk Load Testing**



**Photo 10: M871A3 Trailer Loaded with Pallets of 155MM SLPs & 105MM  
Boxed Ammunition**

DESCRIPTION	WEIGHT
Flatcar Number: ITTX 972861	78,000 lbs.
Pallets of 155MM SLPs and 105MM and dunnage	33,940 lbs.
M871A3 Trailer	17,640 lbs.
Total Specimen Wt.	129,580 lbs.
Buffer Car (four cars)	250,000 lbs.

**Figure 12**

IMPACT NUMBER	AVERAGE VELOCITY (MPH)
1	4.3
2	6.3
3	8.5
4	8.3

Figure 13

**Remarks:**

1. Following Impact 3 there was 0.125 inch of movement between the wood stanchion and the trailer plate.
2. Following Impact 3 the 105MM wood boxes moved 0.375 inch away from the bulkhead.
3. Impacts 1-3 were conducted with the rear of the trailer facing the direction of impact. Impact 4 was conducted with the front of the trailer facing the direction of impact.
4. No damage or excessive movement occurred with the trailer or cargo during testing.
5. The velocity data represents the average speed during the test.

**B. HAZARD COURSE.**



**Photo 11: M871A3 Trailer with Breakbulk Cargo Load**

PASS NO.	ELAPSED TIME	AVERAGE VELOCITY (MPH)
1	29 Seconds	5.3
2	26 Seconds	5.9
3	25 Seconds	6.2
4	26 Seconds	5.9

**Figure 14**

**Remarks:**

1. No damage or excessive movement occurred with the trailer or cargo tie-down rings during testing.
2. Following Pass No. 2, the strapping board broke and the end gate started to collapse. The load straps were tightened. This failure was not a result of the trailer design, and therefore, testing was continued.

3. The velocity data represents the average speed during the test.

C. **ROAD TRIP**: No damage or excessive movement occurred with the trailer or cargo rings during testing.

D. **PANIC STOPS**: Testing was not required since the M871A3 was rail impact tested.

E. **WASHBOARD**: No damage or excessive movement occurred with the trailer or cargo tie-down rings during testing.

#### **5.4 Test Specimen: M871A3 Trailer**

Manufacturer: Fontaine Trailers

Payload: End opening intermodal container with 155MM SLPs. In addition, one pallet of MK-82, 500-pound bombs was secured to the bulkhead of the trailer.

Gross Weight: 45,180 pounds

42,180 pounds (container and 155MM SLPs) plus 3000 pounds for the MK-82 bomb pallet.

Testing Date: 7 November 2001



**Photo 12: Rear Chain Tie-down Configuration of the M871A3  
with Full Payload**

**A. RAIL IMPACT.**

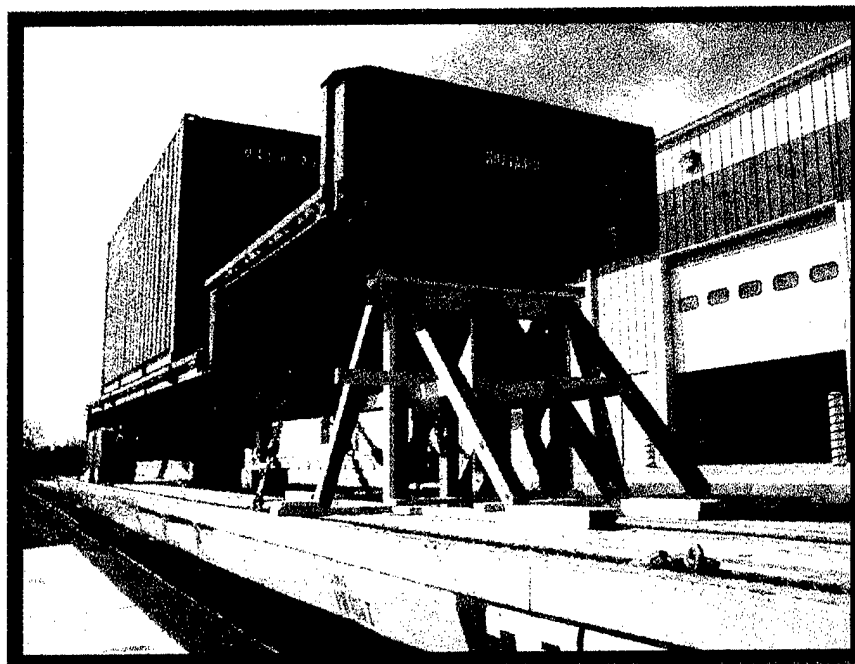


**Photo 13: M871A3 Trailer Testing with Full Payload Chained to the Flatcar**

DESCRIPTION	WEIGHT
Flatcar Number: ITTX 972861	78,000 lbs.
ISO container with 155MM SLPs and additional MK-82 pallet of 500# bombs	45,180 lbs.
M871A3 Trailer	17,640 lbs.
Total Specimen Wt.	140,820 lbs.
Buffer Car (four cars)	250,000 lbs.

**Figure 15**





**Photo 14: Wood Stanchion for Full Payload Testing**

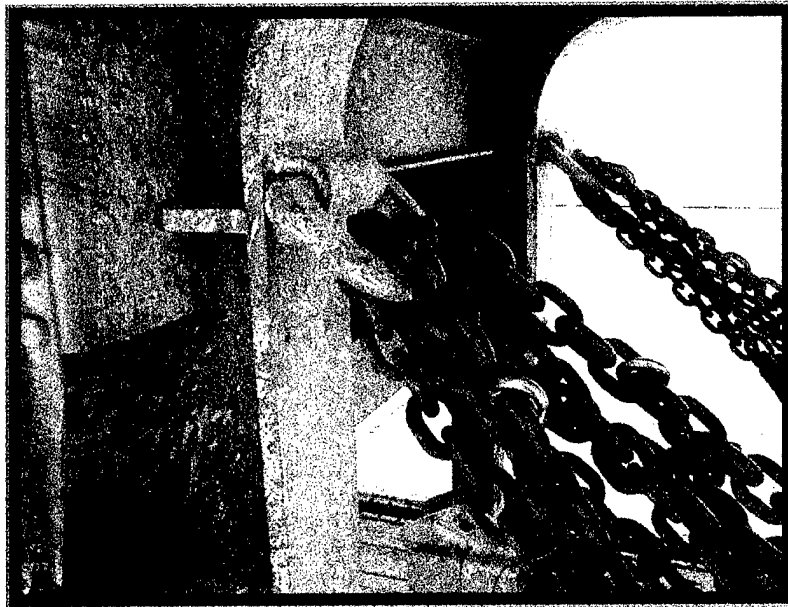
IMPACT NUMBER	AVERAGE VELOCITY (MPH)
1	4.1
2	6.2
3	8.3
4	8.5

**Figure 16**

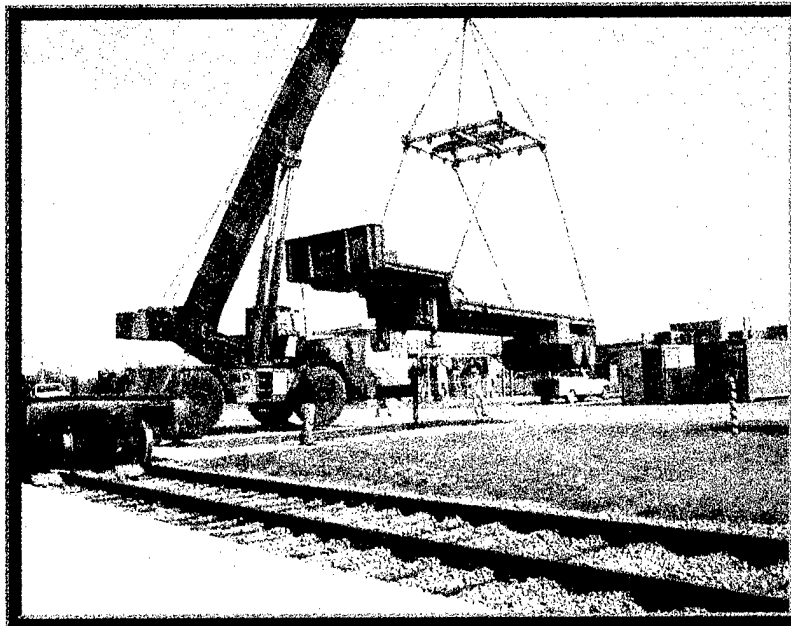
**Remarks:**

1. No damage or excessive movement occurred with the trailer, tiedown rings, or twistlocks during testing. Chains remained tight throughout testing.

2. Impacts 1-3 were conducted within the rear of the trailer facing the direction of impact. Impact 4 was conducted with the front of the trailer facing the direction of impact.
3. The velocity data represents the average speed during the test.



**Photo 15:** Chain tiedown configuration on forward end of the M871A3



**Photo 16:** Unloading of Empty M871A3 Trailer from the Flatcar

## **PART 6 – ACCELEROMETER DATA**

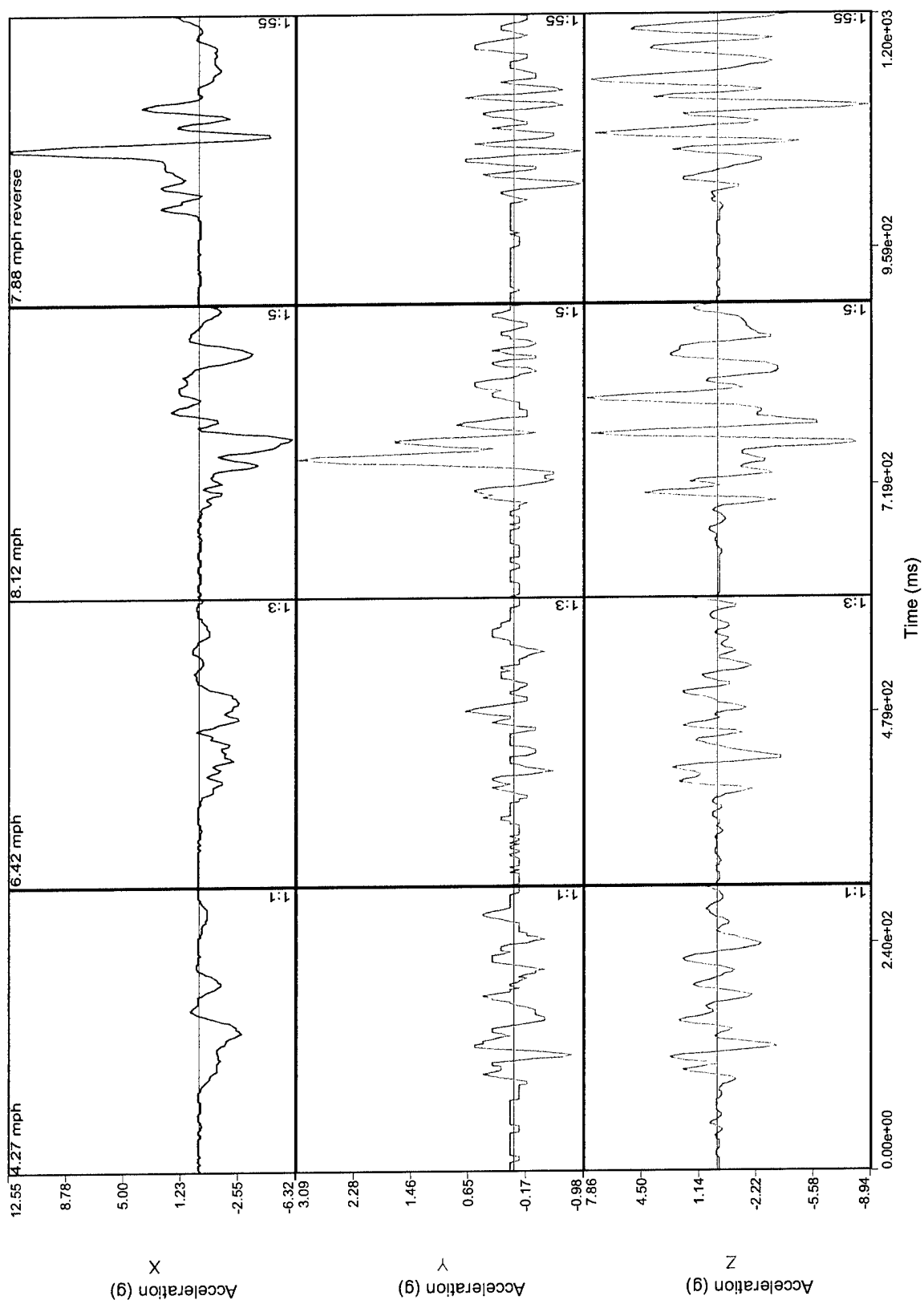
The first accelerometers were located in various areas on the test specimen. These areas are described on each of the following graphic depictions of each of the railcar impacts, hazard course, road course, and washboard course. The axial orientation of the accelerometers is as follows:

x – longitudinal axis      y – lateral axis      z – vertical axis

A table depicting the identification and location of the graphic illustrations is below:

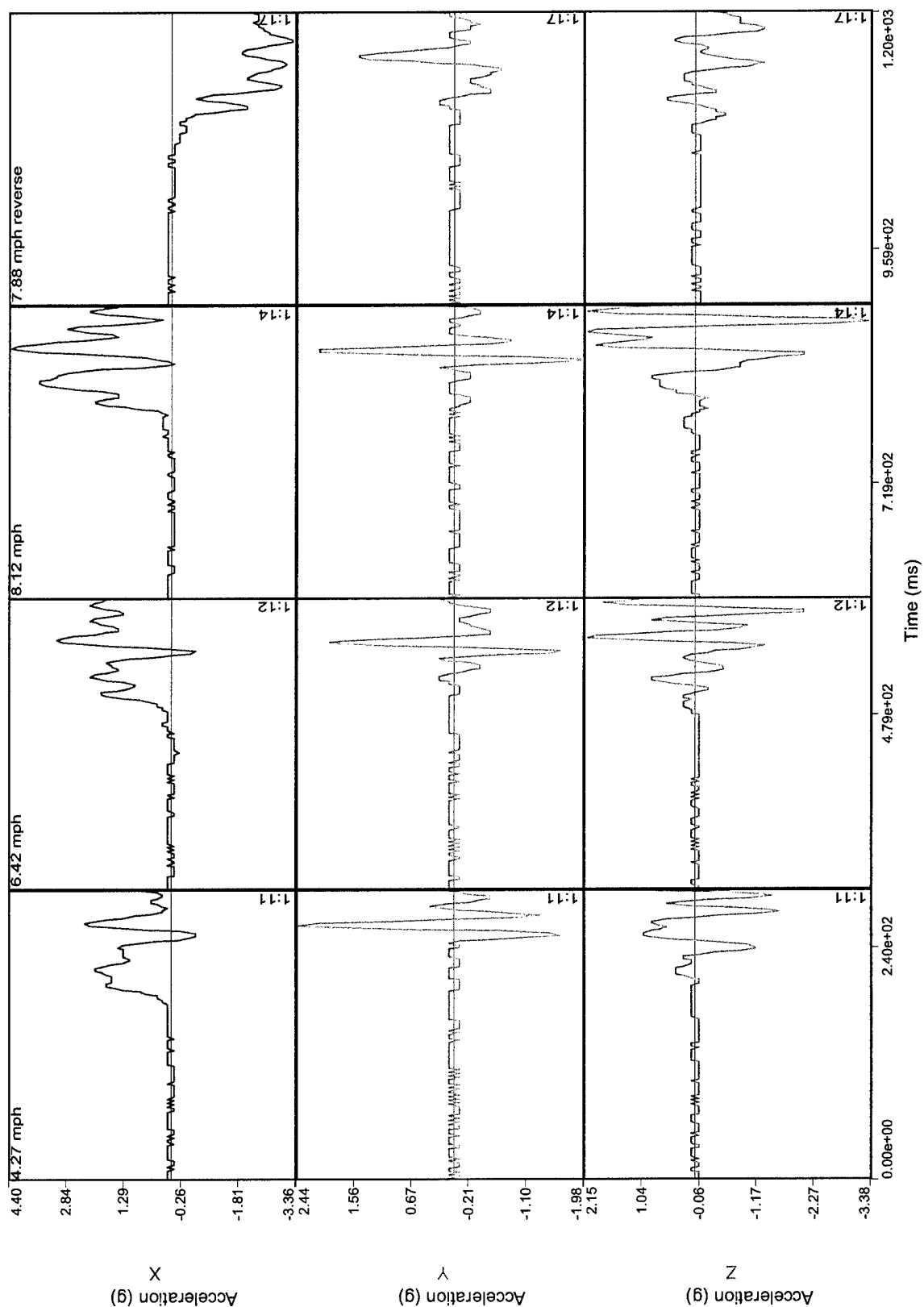
<b>M871A3</b>			
<b>TEST LOAD</b>	<b>TEST</b>	<b>PAGE</b>	<b>SENSOR LOCATION</b>
11,859# Payload	Rail Impact	6-2	Rear Railcar
11,859# Payload	Rail Impact	6-3	Rear Trailer
11,859# Payload	Hazard Course	6-4/5	Trailer Bulkhead
11,859# Payload	Hazard Course	6-6/7	Rear Trailer
11,859# Payload	Road Trip	6-8	Rear Trailer
11,859# Payload	Road Trip	6-9	Trailer Bulkhead
11,859# Payload	Washboard Course	6-10	Trailer Bulkhead
11,859# Payload	Washboard Course	6-11	Rear Trailer
45,180# Payload	Rail Impact	6-12	Rear Trailer
45,180# Payload	Rail Impact	6-13	Rear Trailer
45,180# Payload	Rail Impact	6-14	Trailer Bulkhead
45,180# Payload	Hazard Course	6-15	Trailer Bulkhead
45,180# Payload	Washboard Course	6-16	Trailer Bulkhead
45,180# Payload	Retest- Rail Impact	6-17	Rear Railcar
45,180# Payload	Retest- Rail Impact	6-18	Trailer Bulkhead
45,180# Payload	Retest- Rail Impact	6-19	Rear Trailer
33,940# Payload	Rail Impact	6-20	Rear Railcar
33,940# Payload	Rail Impact	6-21	Trailer Bulkhead
33,940# Payload	Rail Impact	6-22	Rear Trailer
33,940# Payload	Hazard Course	6-23/24	Trailer Bulkhead
33,940# Payload	Hazard Course	6-25/26	Rear Trailer
33,940# Payload	Road Trip	6-27	Trailer Bulkhead
33,940# Payload	Road Trip	6-28	Rear Trailer
33,940# Payload	Washboard Course	6-29	Trailer Bulkhead
33,940# Payload	Washboard Course	6-30	Rear Trailer
45,180# Payload	Rail Impact	6-31	Rear Railcar
45,180# Payload	Rail Impact	6-32	Rear Trailer

# Rail Impact of M871A3 Trailer with 11,859-lb. Payload Sensor Location: Rear Railcar



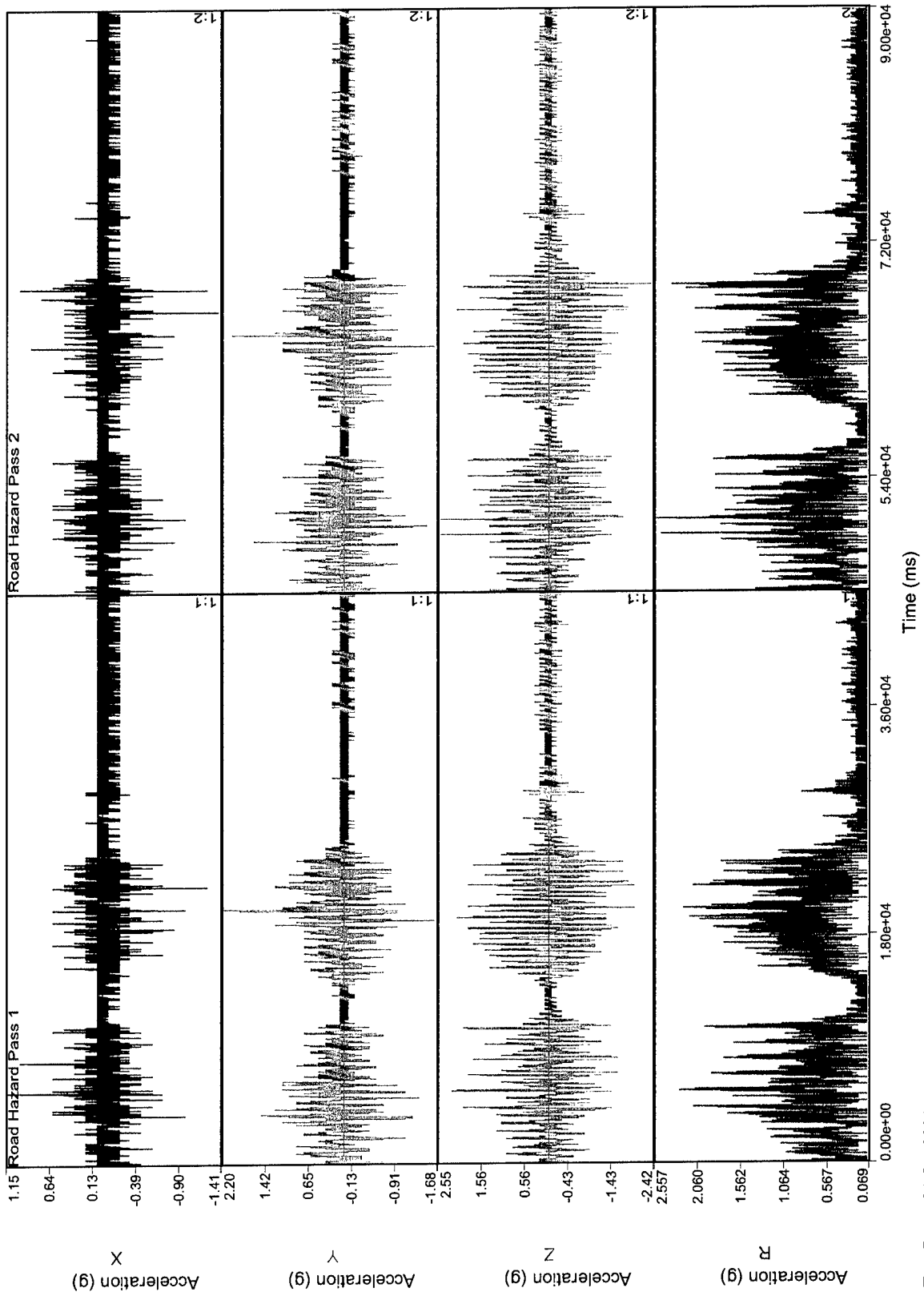
Test Date: 29 Oct 2001

# Rail Impact of M871A3 Trailer with 11,859-lb. Payload Sensor Location: Trailer Rear



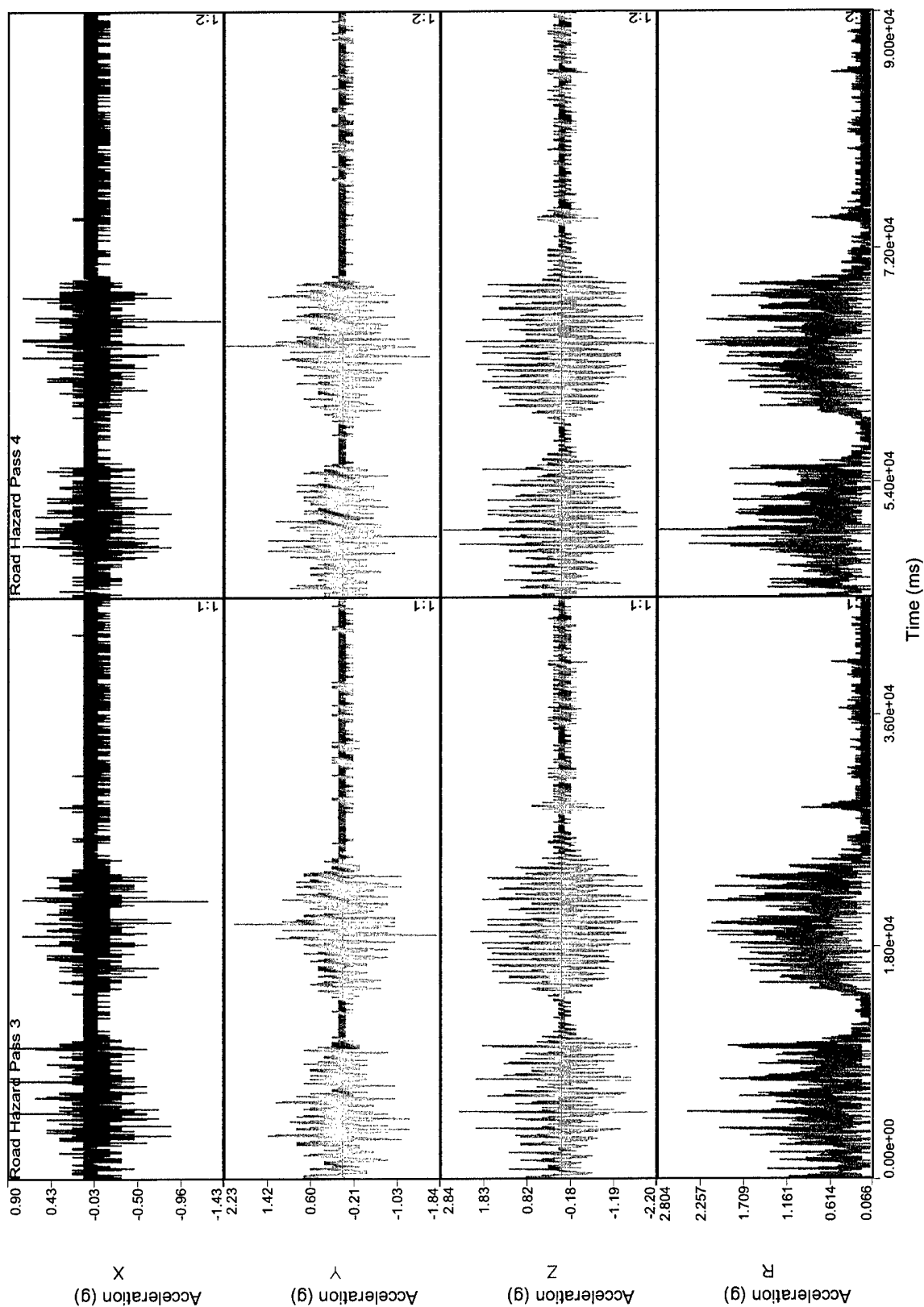
Test Date: 29 Oct 2001

Hazard of M871A3 Trailer with 11,859-lb. Payload      Sensor Location: Trailer Bulkhead



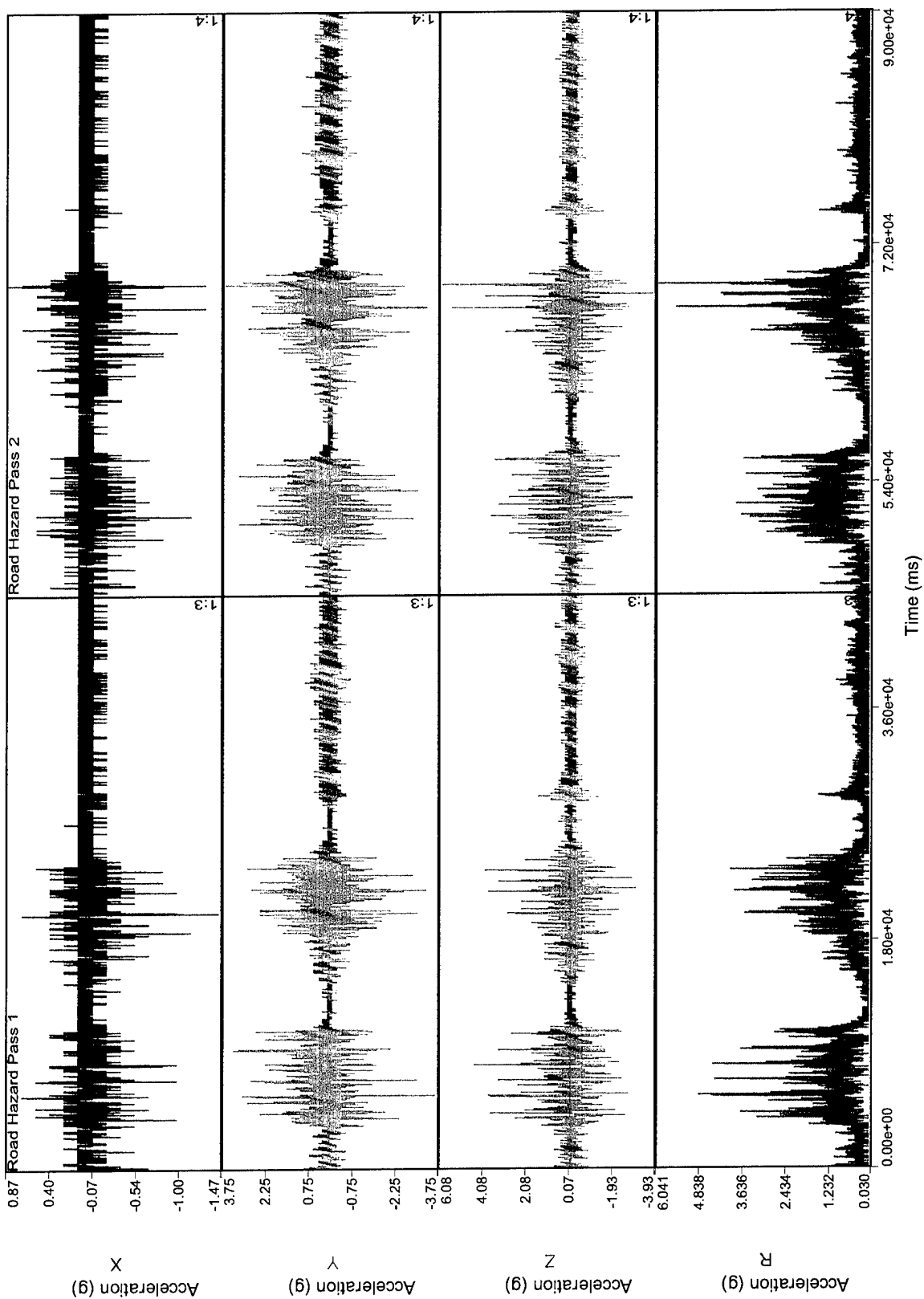
Test Date: 31 Oct 2001

Hazard of M871A3 Trailer with 11,859-lb Payload      Sensor Location: Trailer Bulkhead



Test Date: 31 Oct 2001

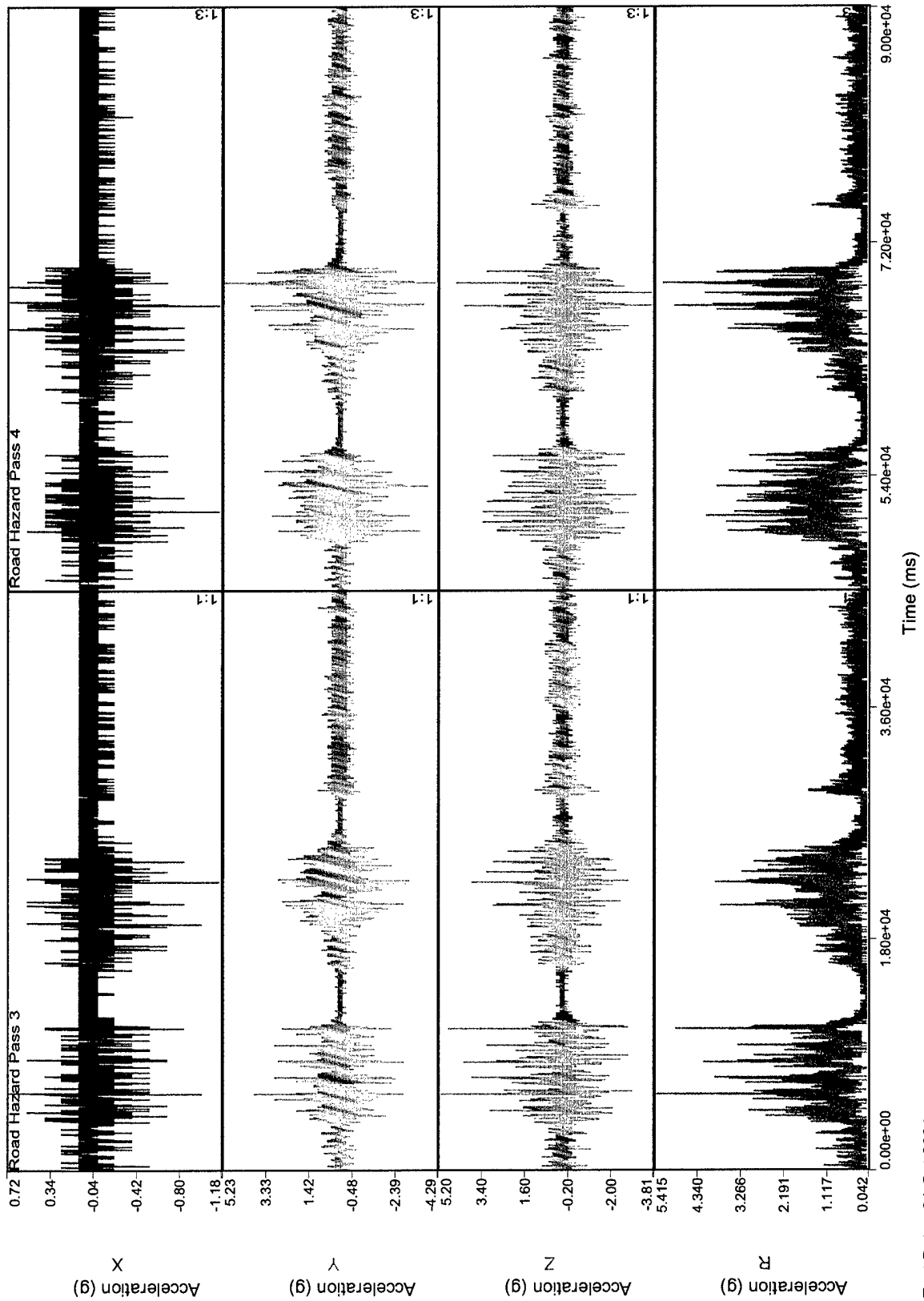
Hazard of M871A3 Trailer with 11,859-lb Payload      Sensor Location: Trailer Rear



Test Date: 31 Oct 2001

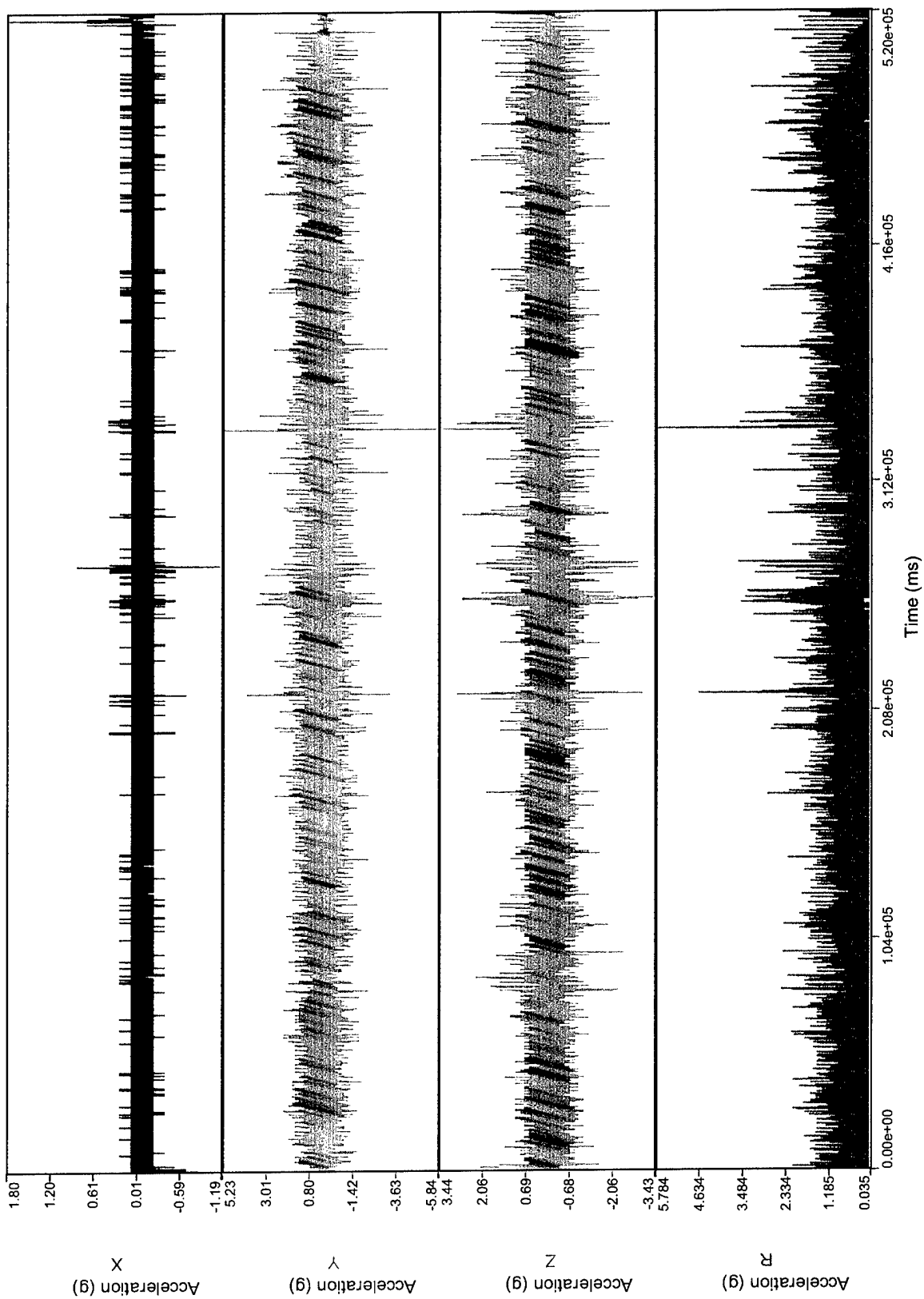


Hazard of M871A3 Trailer with 11,859-lb Payload      Sensor Location: Trailer Rear

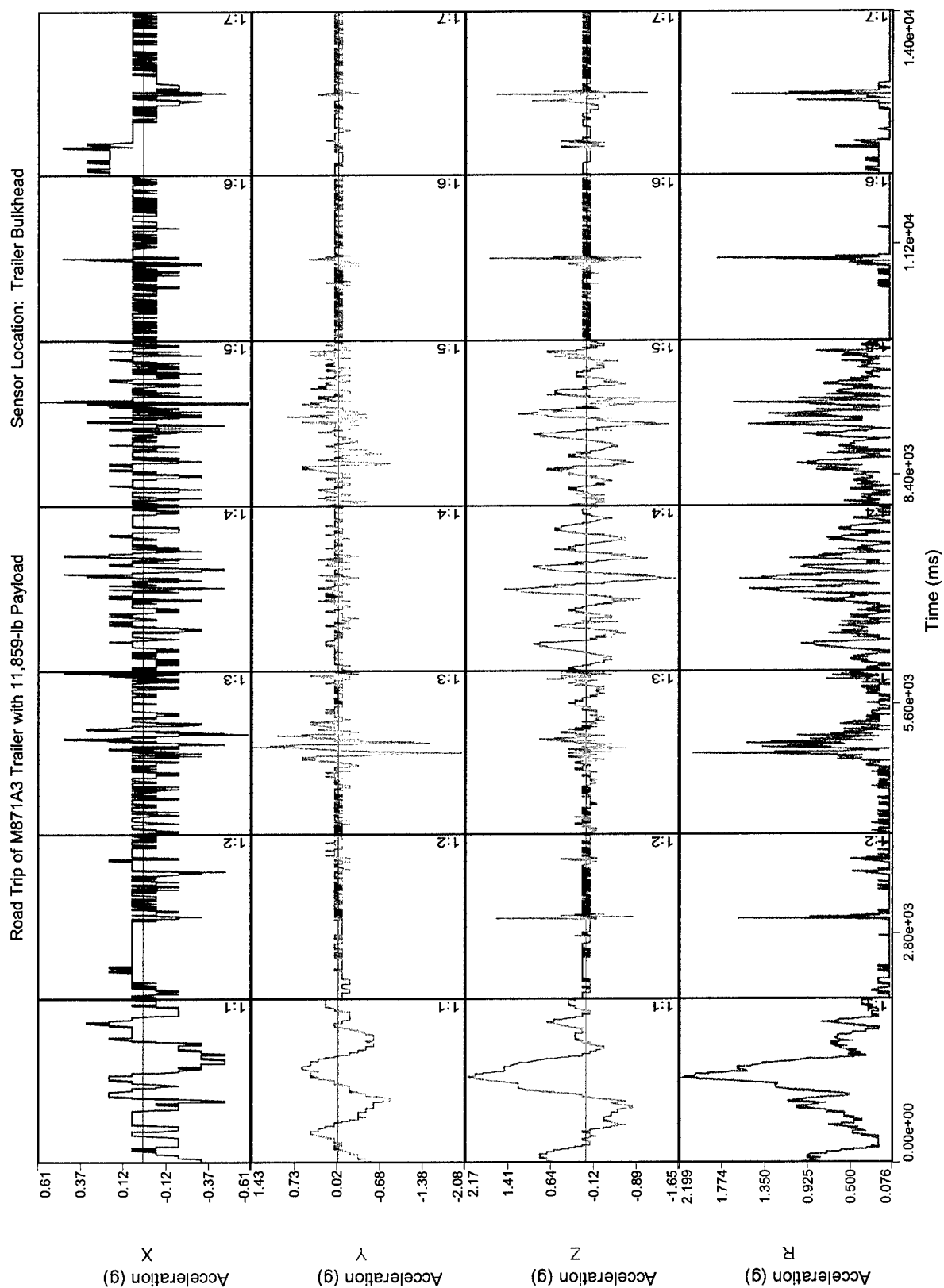


Test Date: 31 Oct 2001

Road Trip of M871A3 Trailer with 11,859-lb Payload      Sensor Location: Trailer Rear



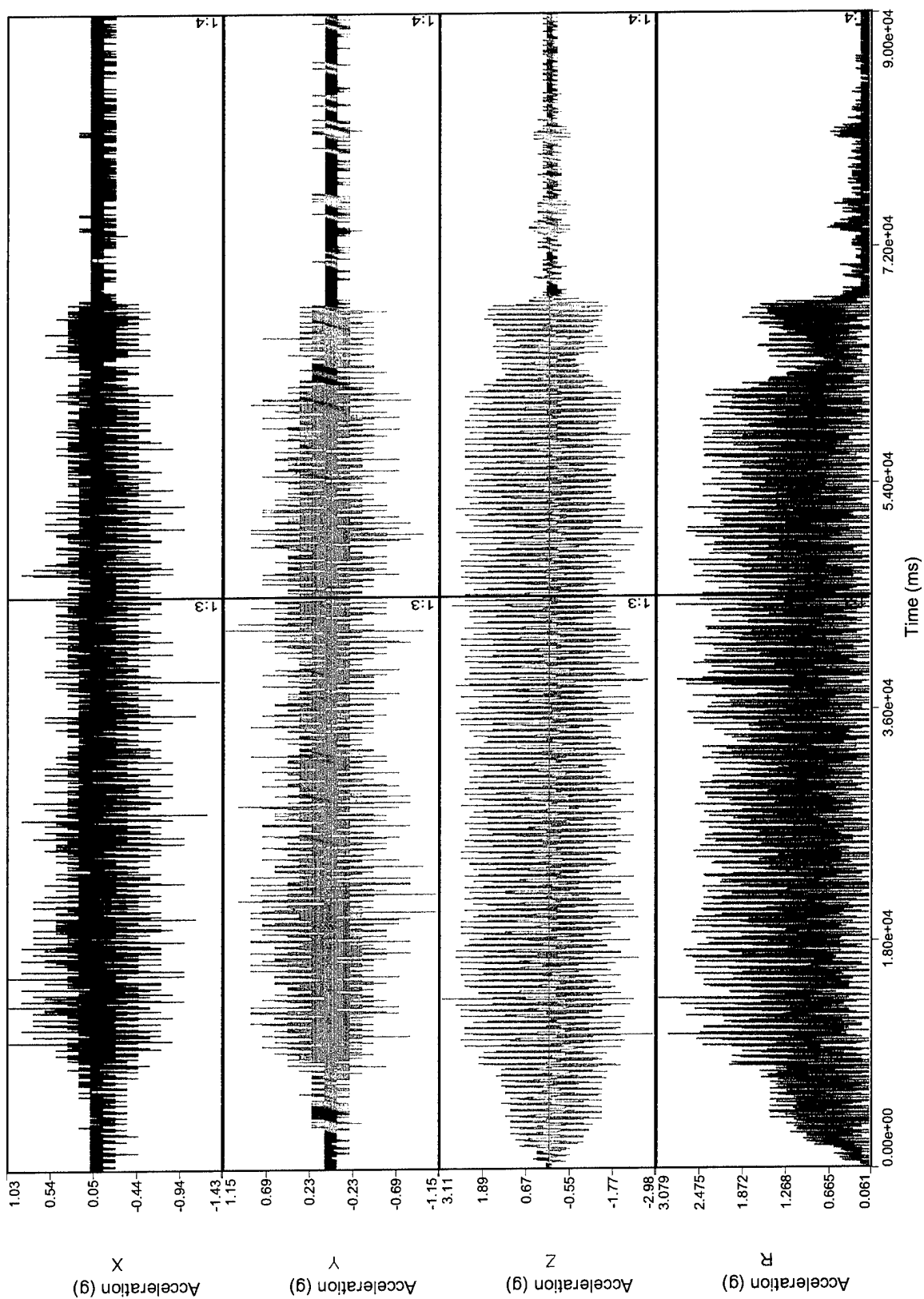
Test Date: 31 Oct 2001



Test Date: 31 Oct 2001

Washboard Course of M87/A3 Trailer with 11,859-lb Payload

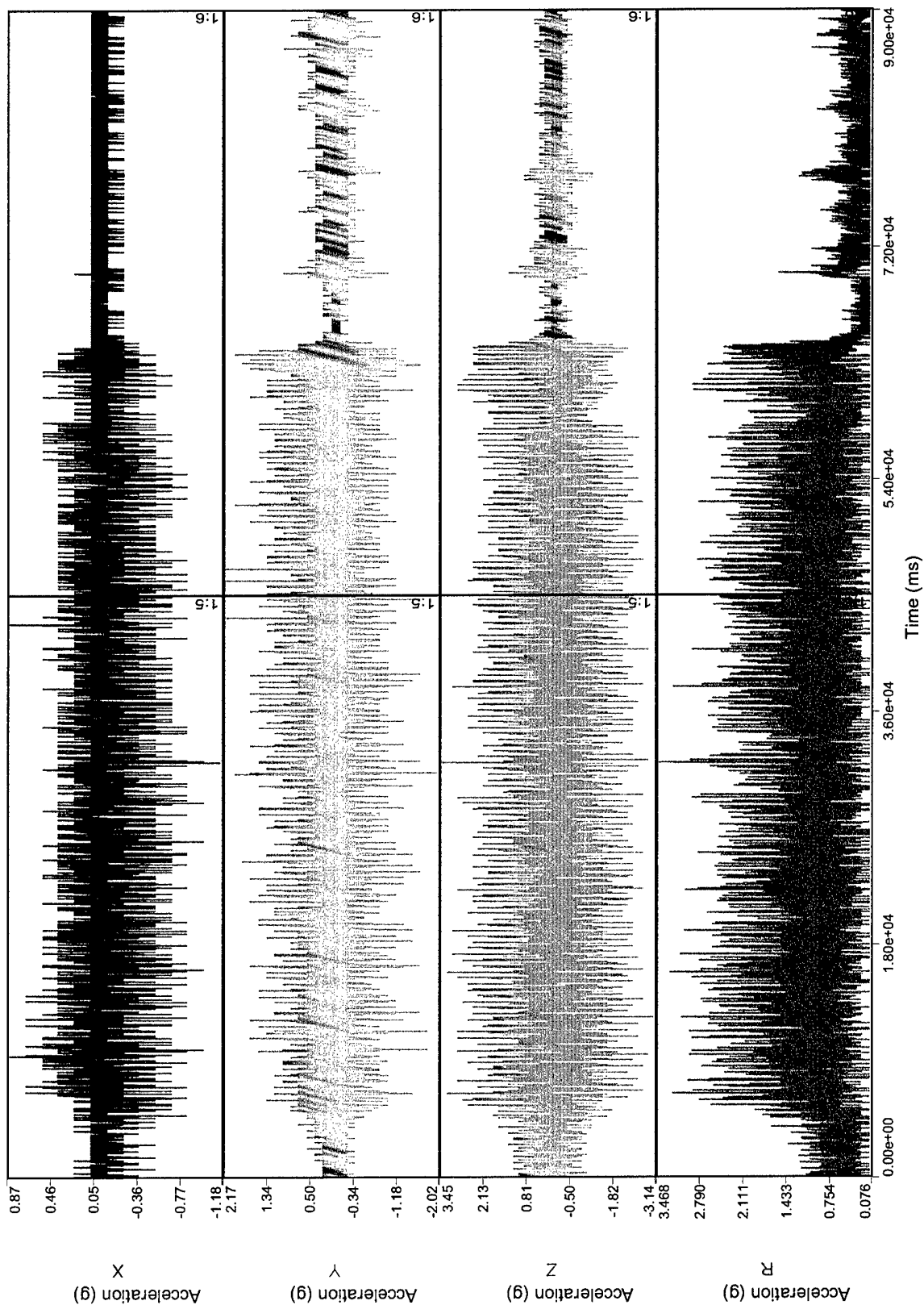
Sensor Location: Trailer Bulkhead



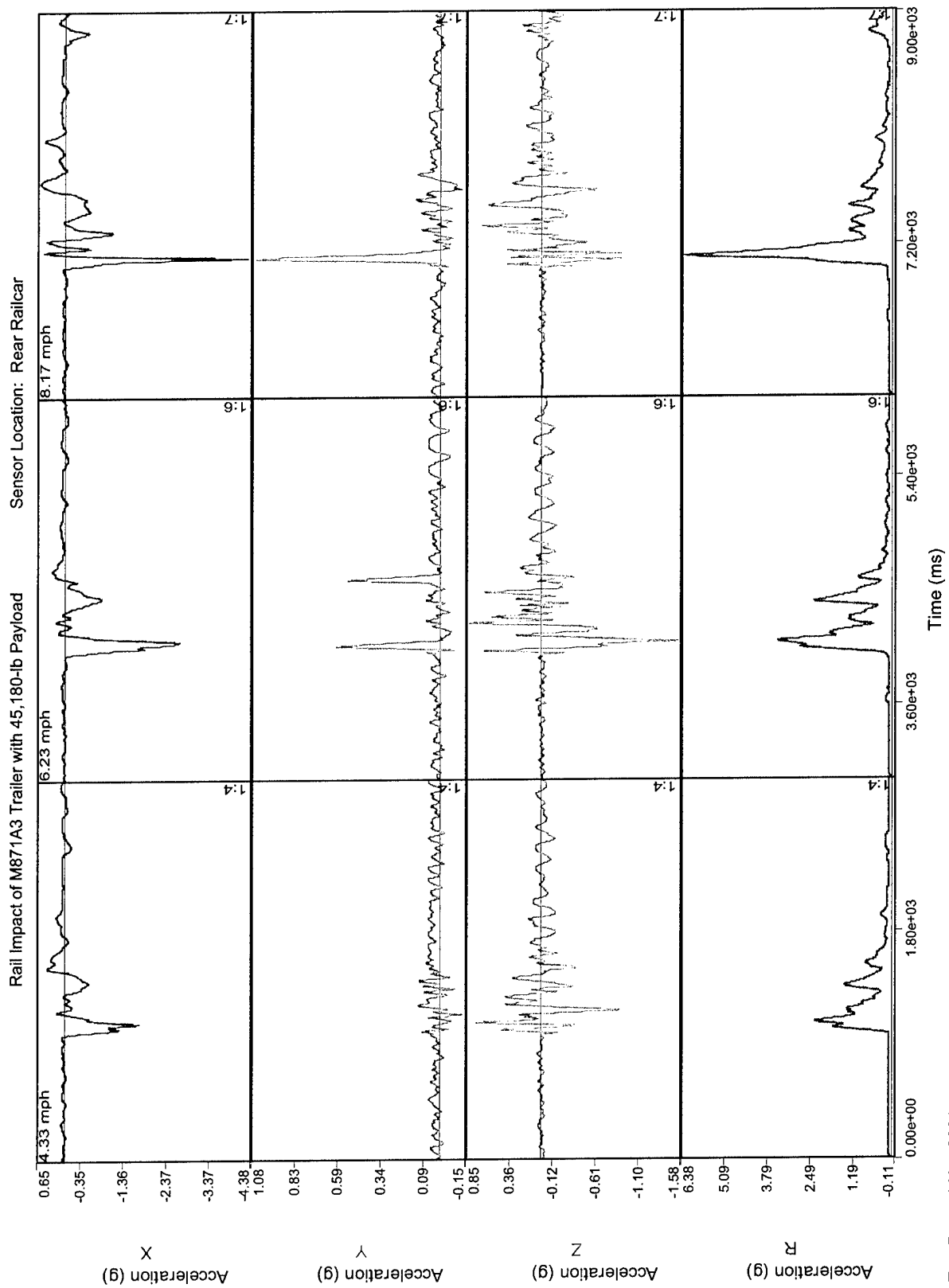
Test Date: 31 Oct 2001

Washboard Course of M871A3 Trailer with 11,859-lb Payload

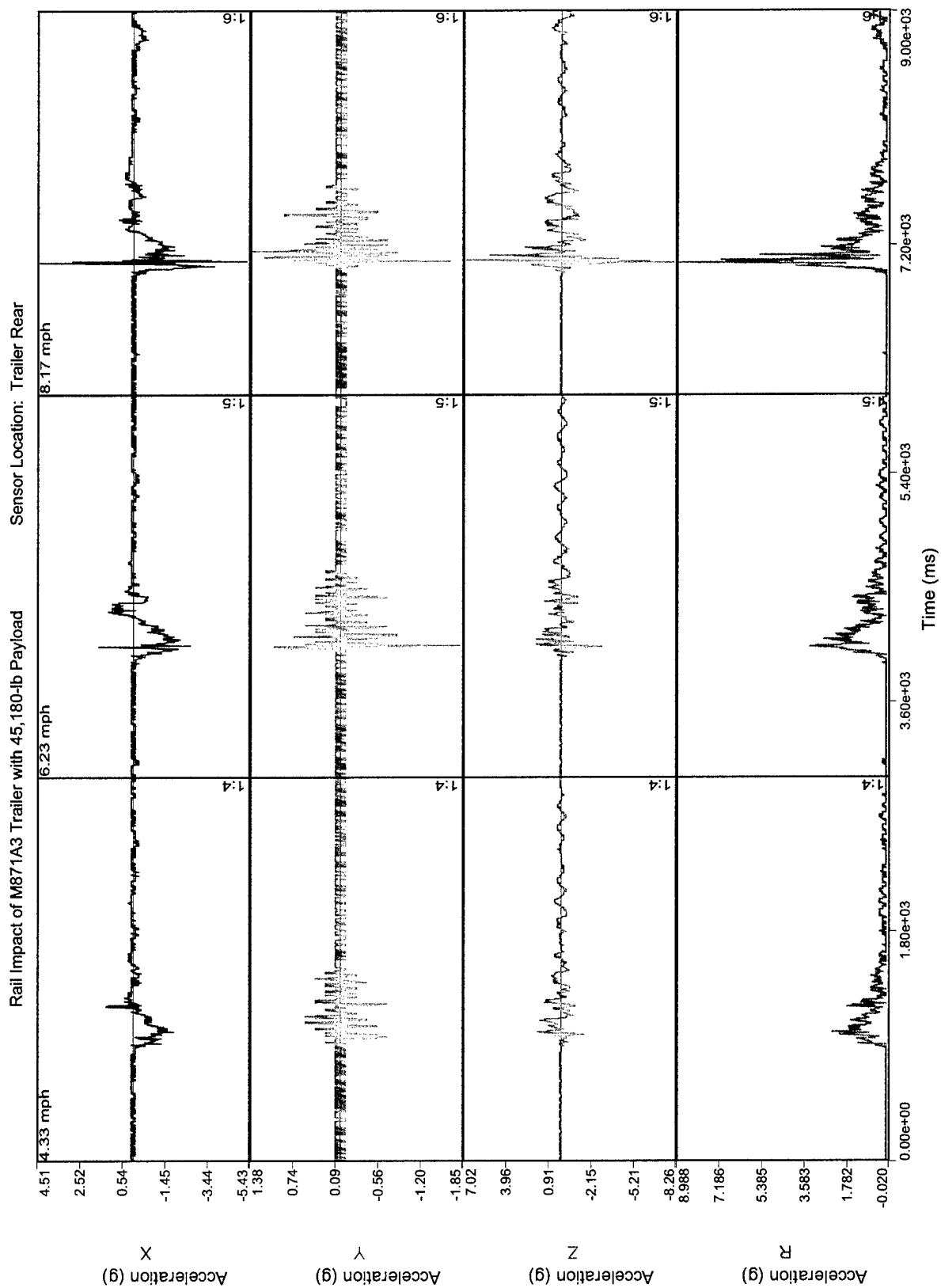
Sensor Location: Trailer Rear



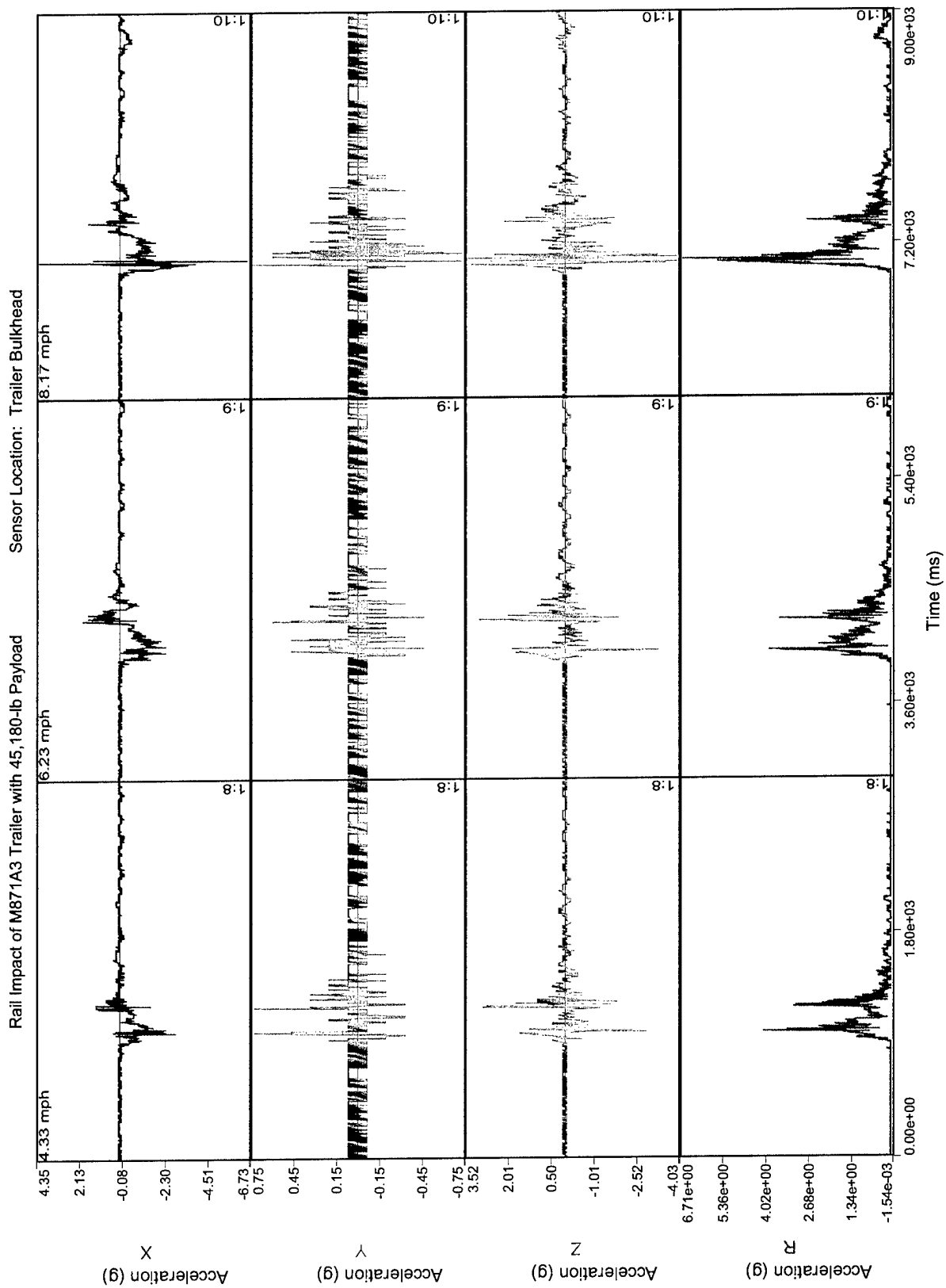
Test Date: 31 Oct 2001



Test Date: 1 Nov 2001



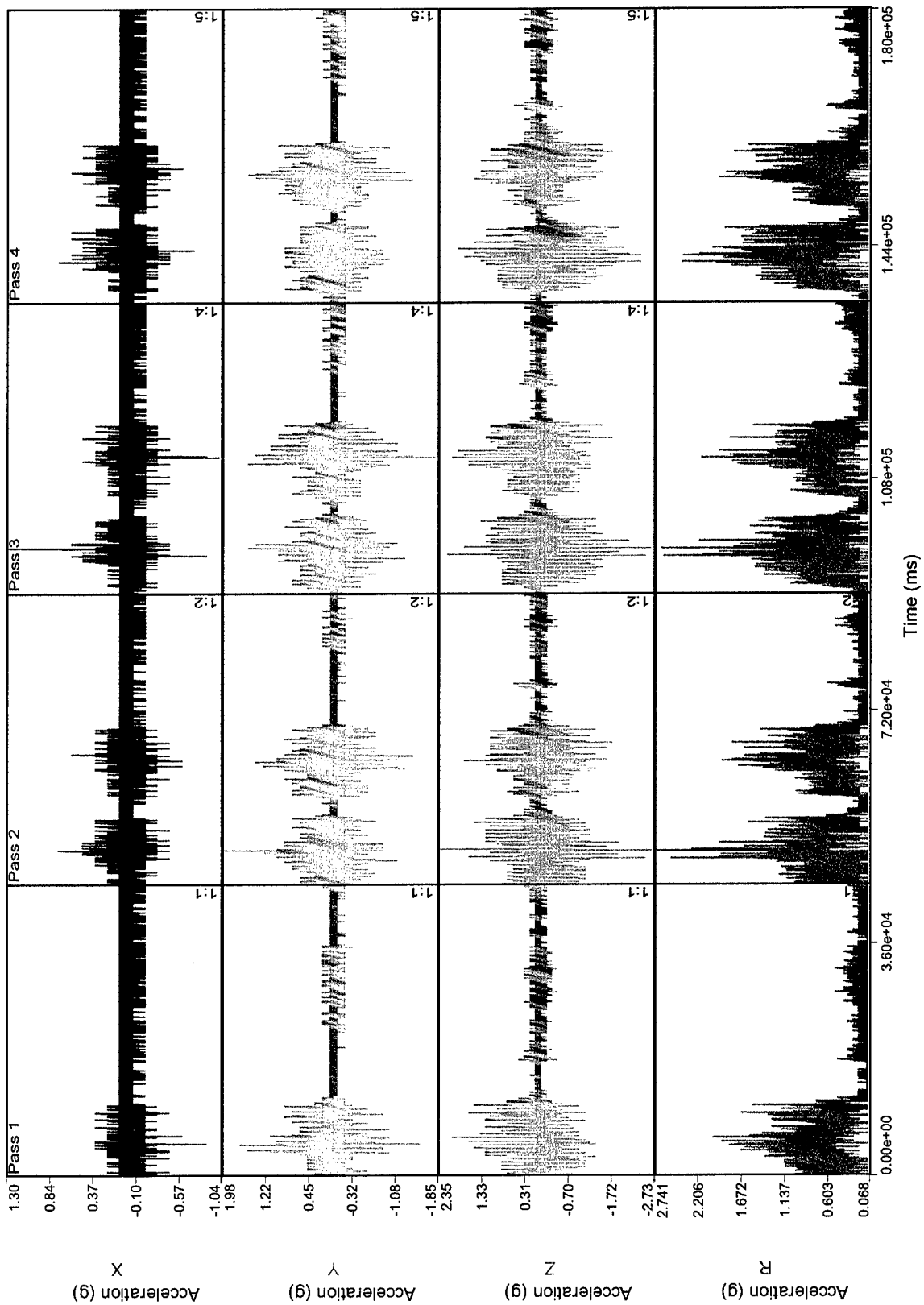
Test Date: 1 Nov 2001



Test Date: 1 Nov 2001

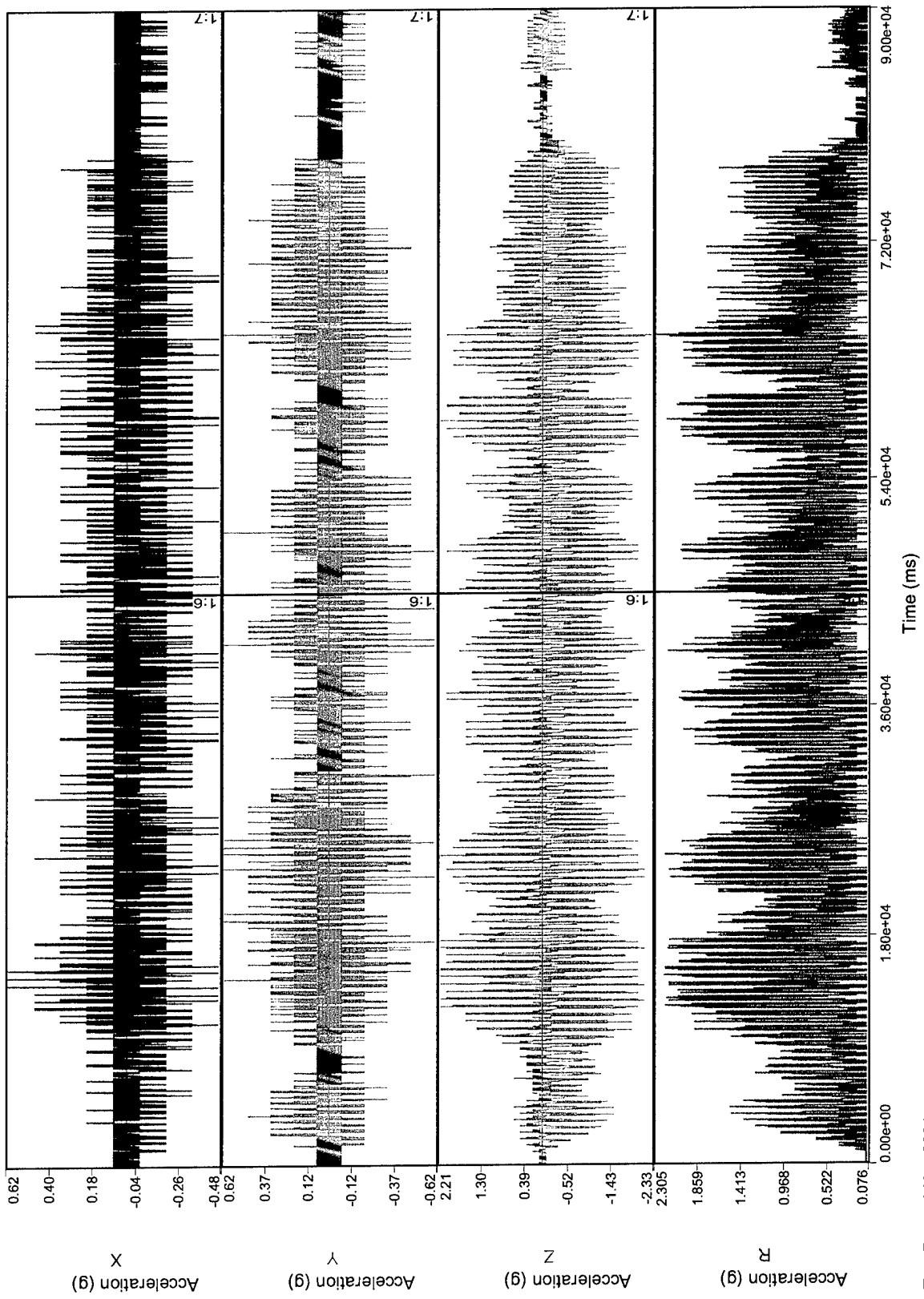


Hazard Course of M871A3 Trailer with 45,180-lb Payload      Sensor Location: Trailer Bulkhead

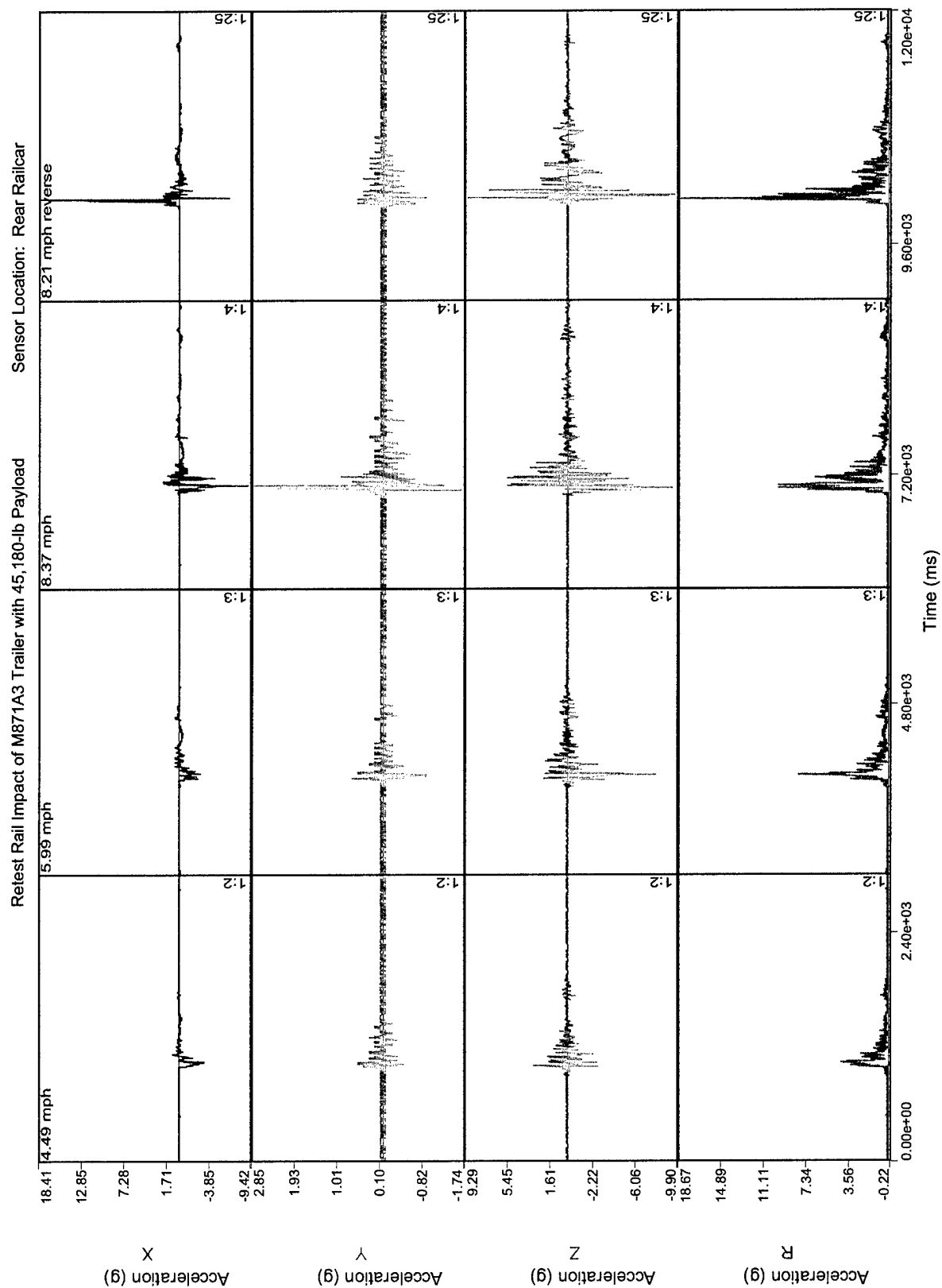


Test Date: 1 Nov 2001

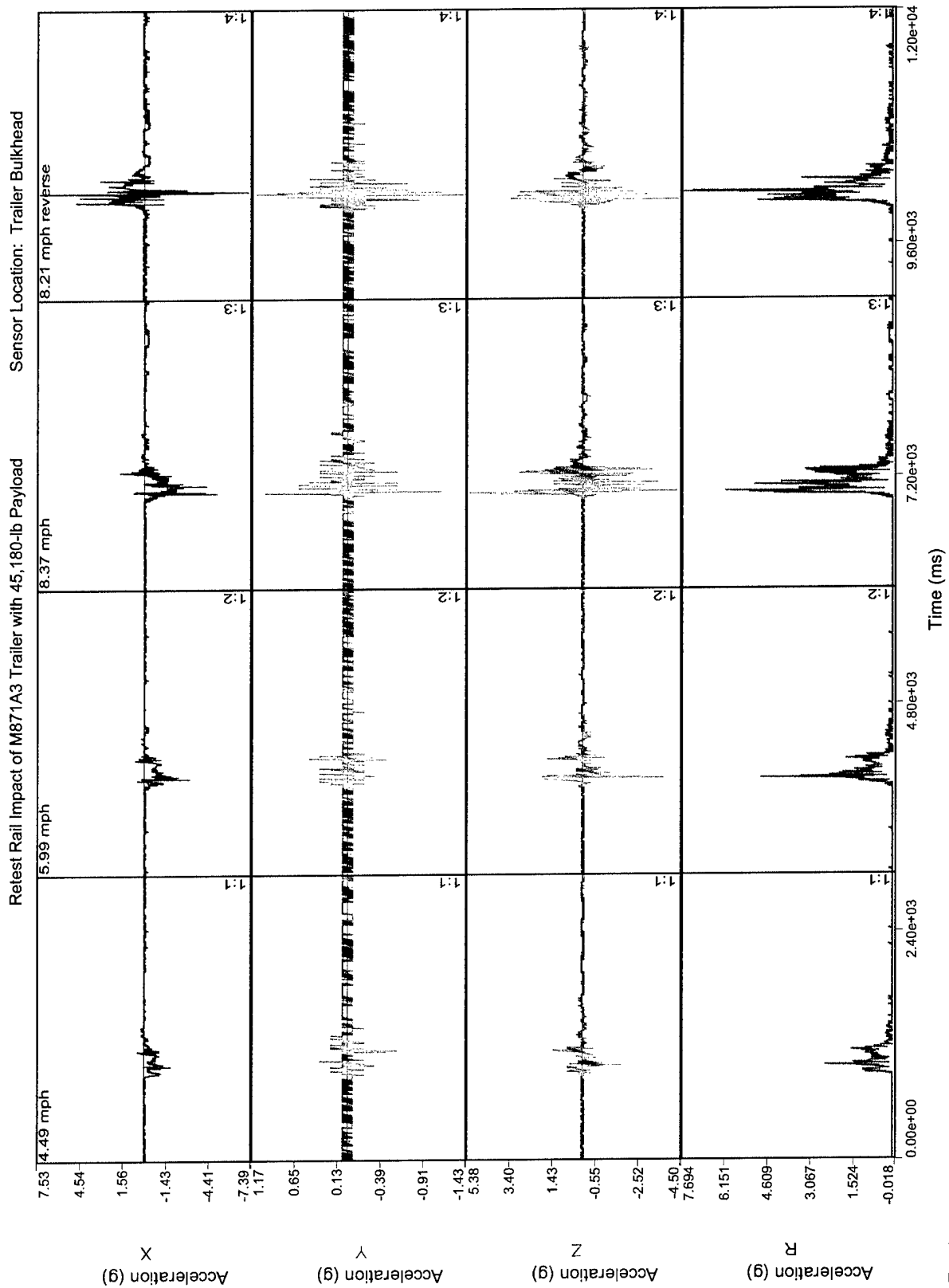
Dashboard Course of M871A3 Trailer with 45,180-lb Payload      Sensor Location: Trailer Bulkhead



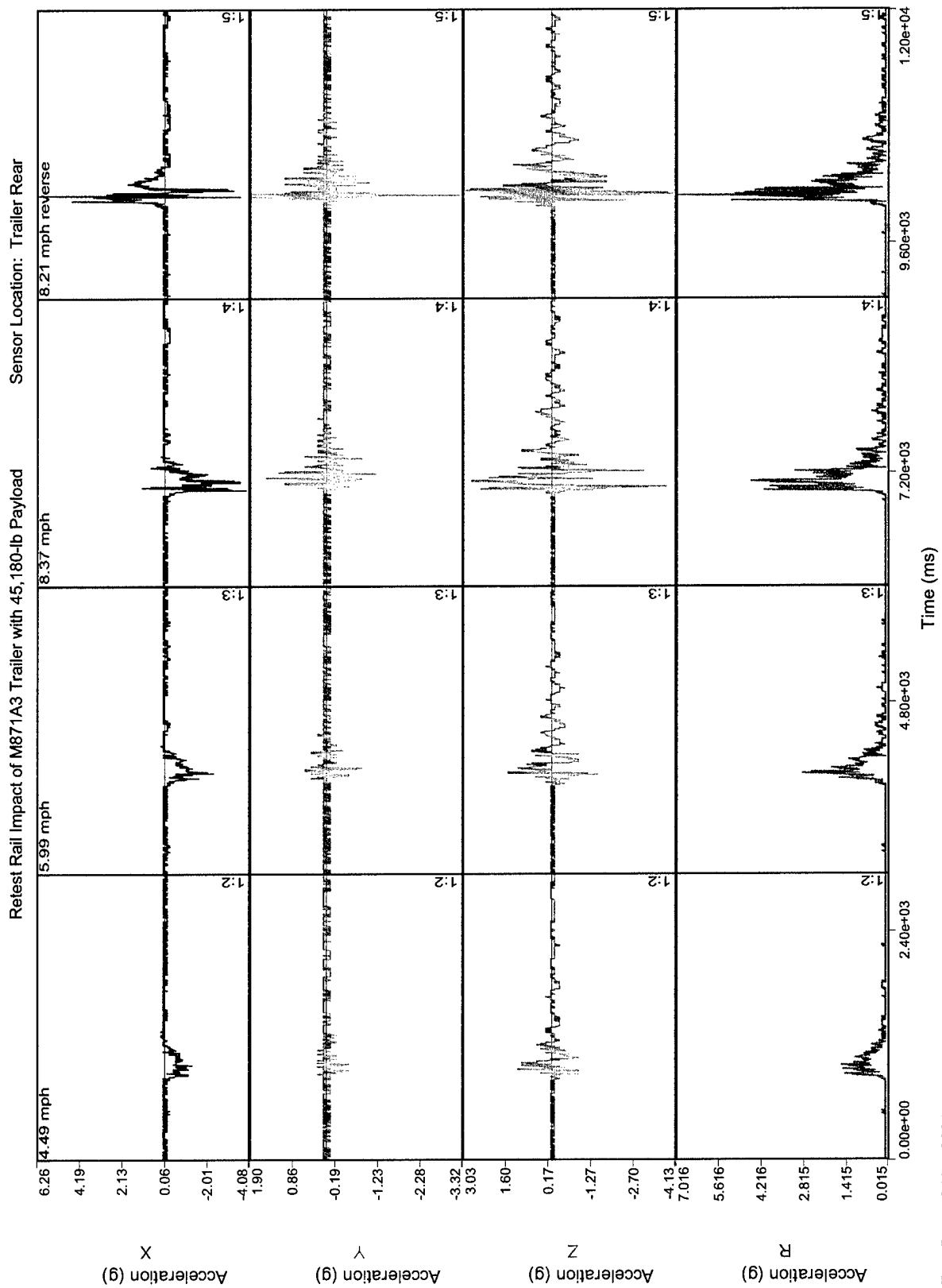
Test Date: 1 Nov 2001



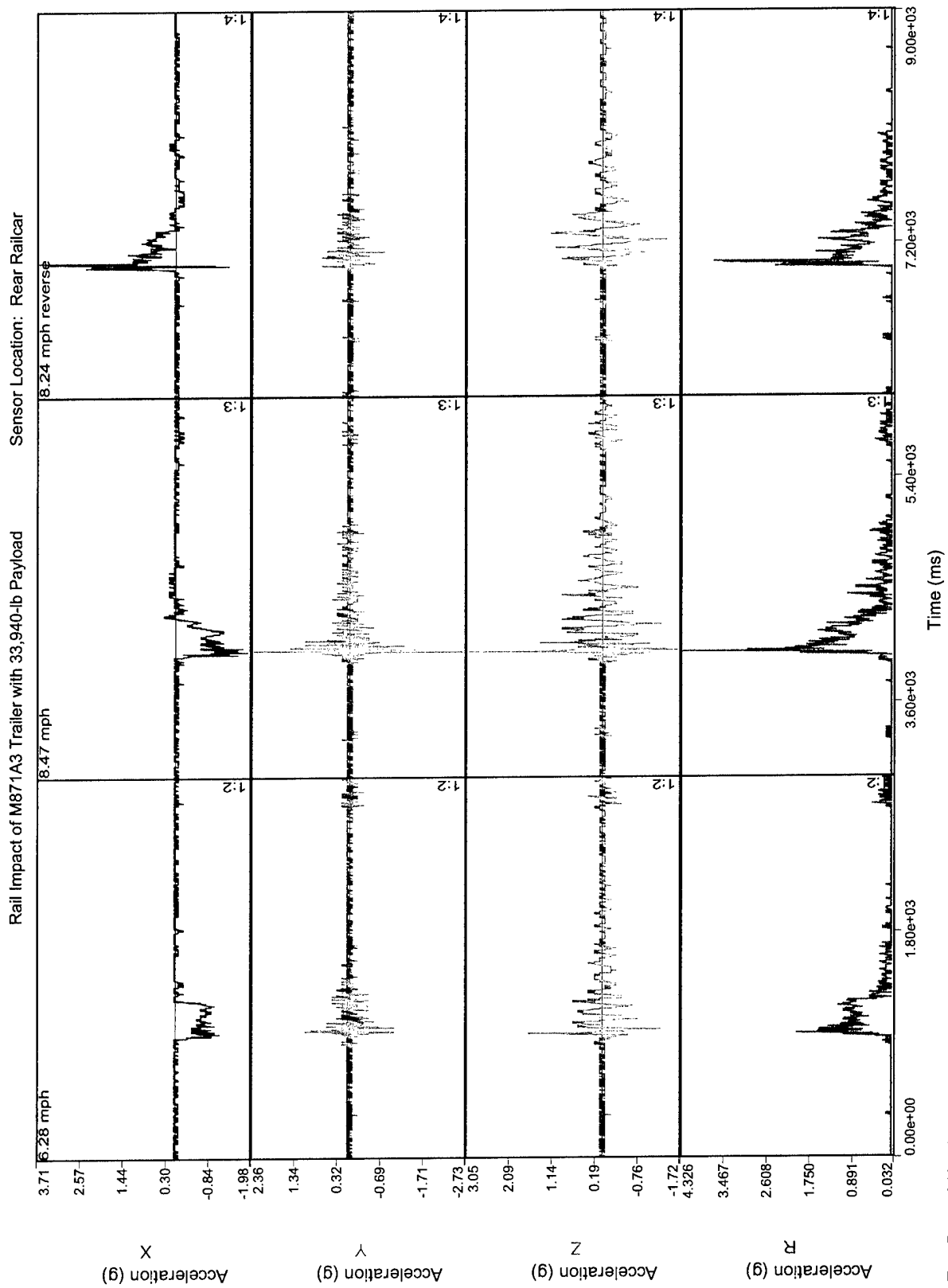
Test Date: 8 Nov 2001

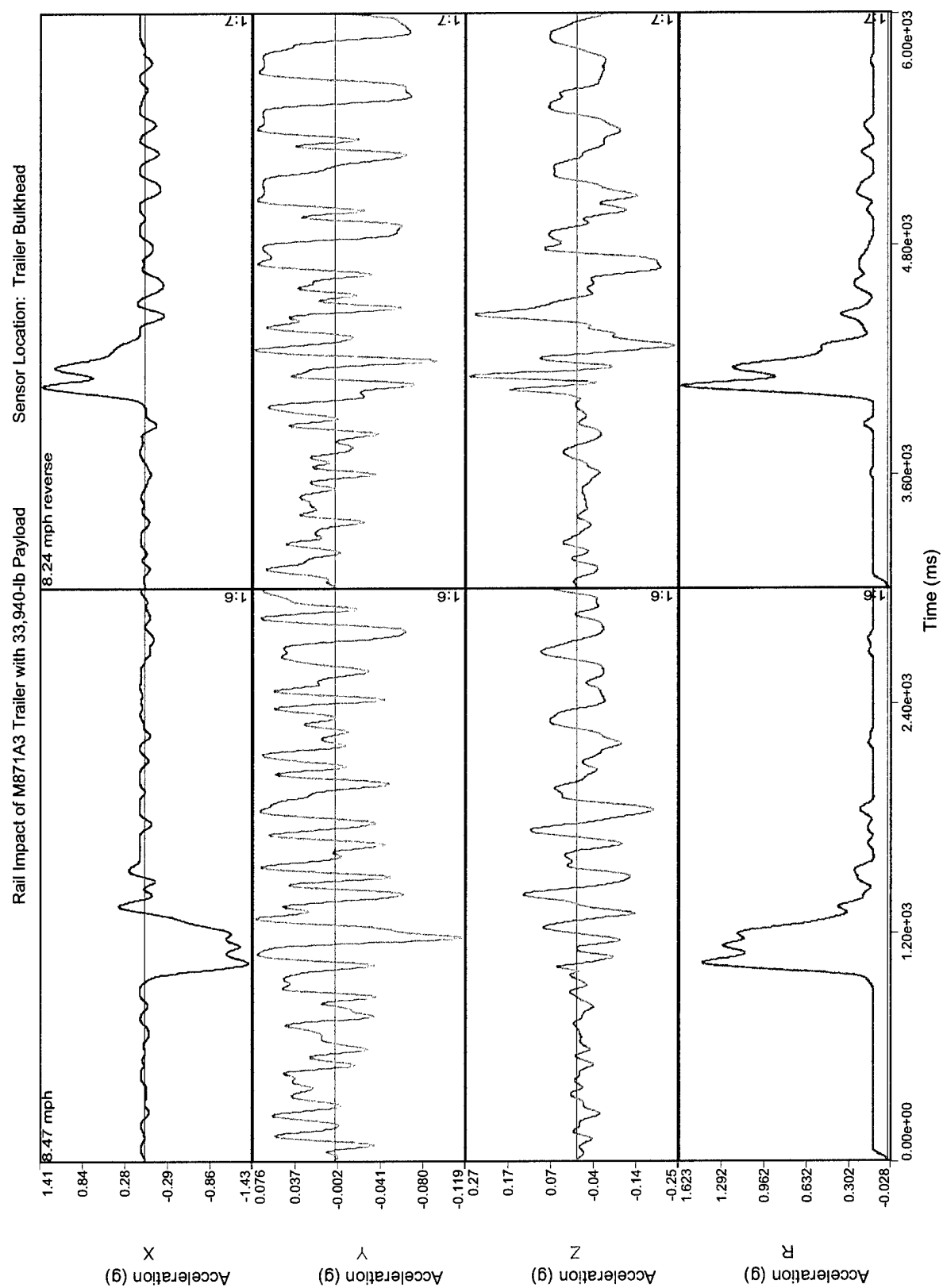


Test Date: 8 Nov 2001

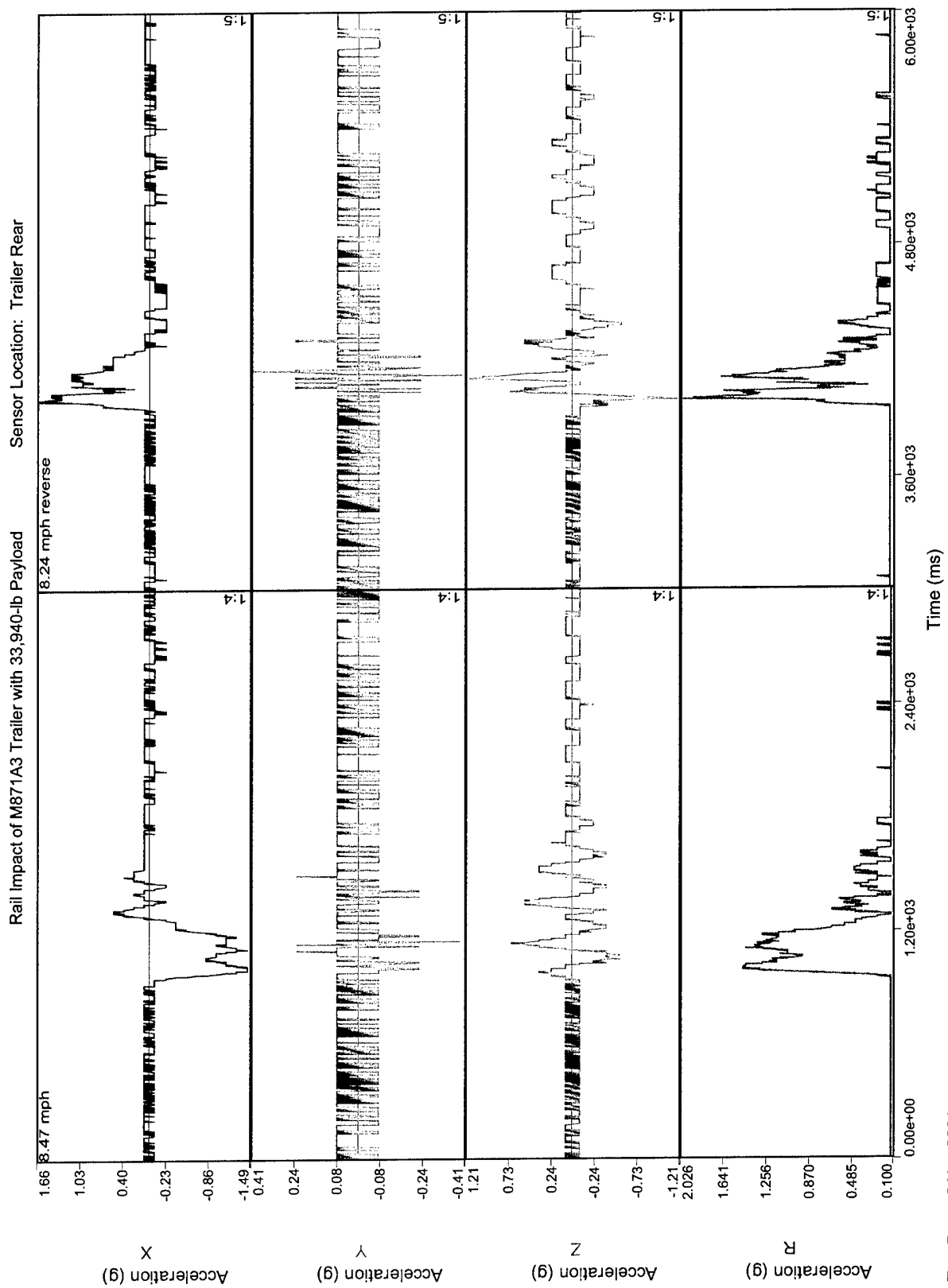


Test Date: 8 Nov 2001



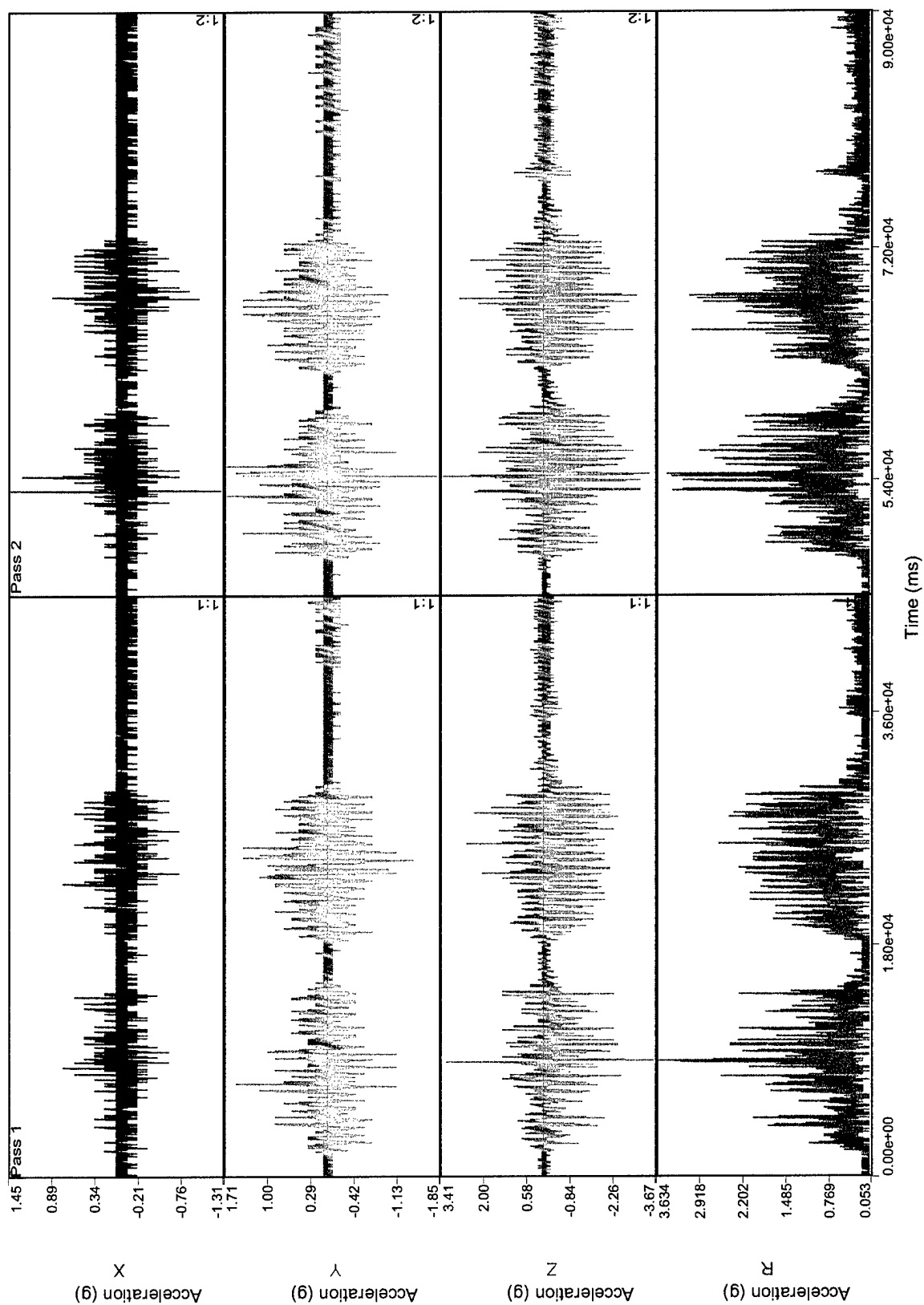


Test Date: 6 Nov 2001



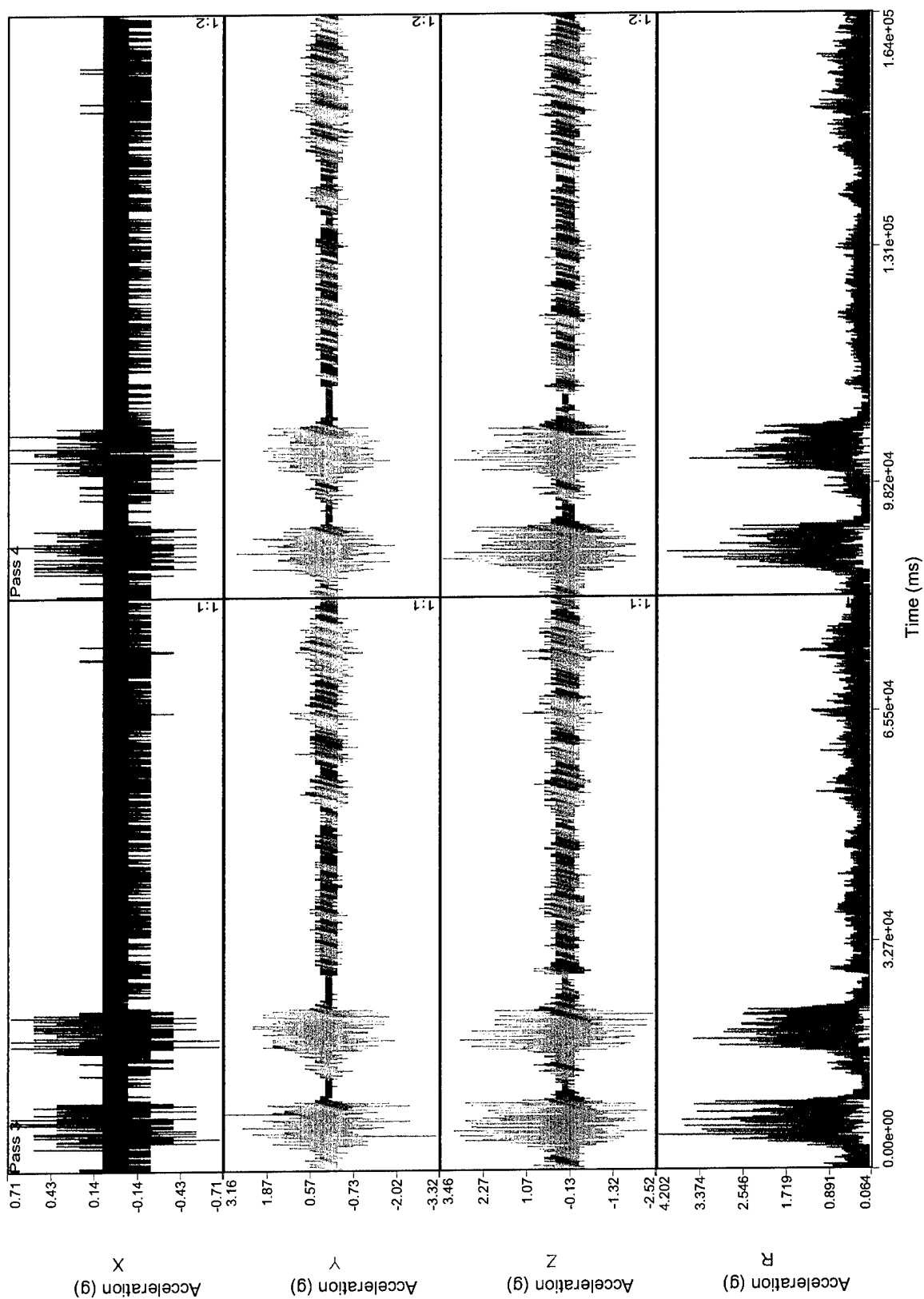


Hazard Course of M871A3 Trailer with 33,940-lb Payload      Sensor Location: Trailer Bulkhead



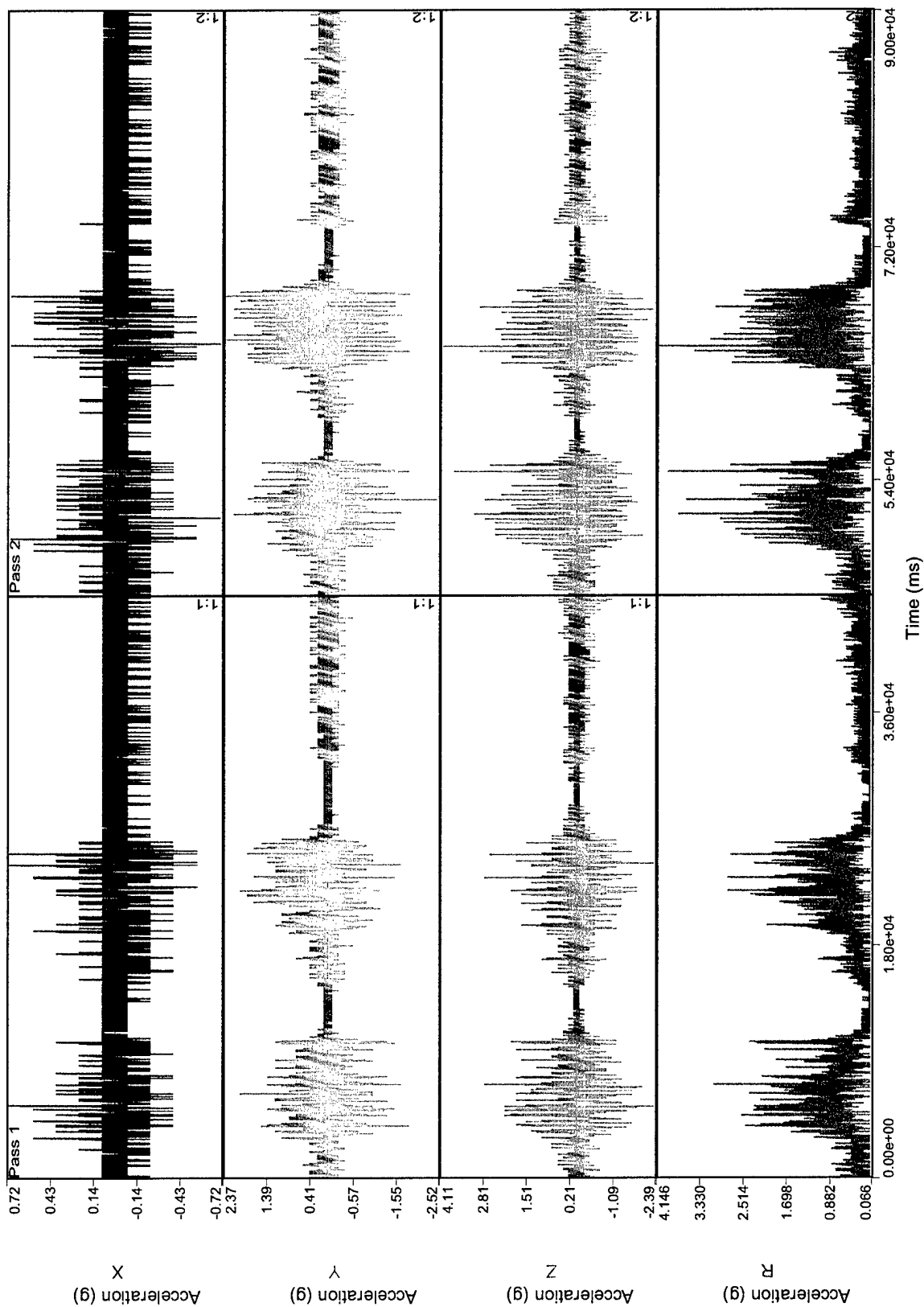
Test Date: 6 Nov 2001

Hazard Course of M871A3 Trailer with 33,940-lb Payload      Sensor Location: Trailer Bulkhead



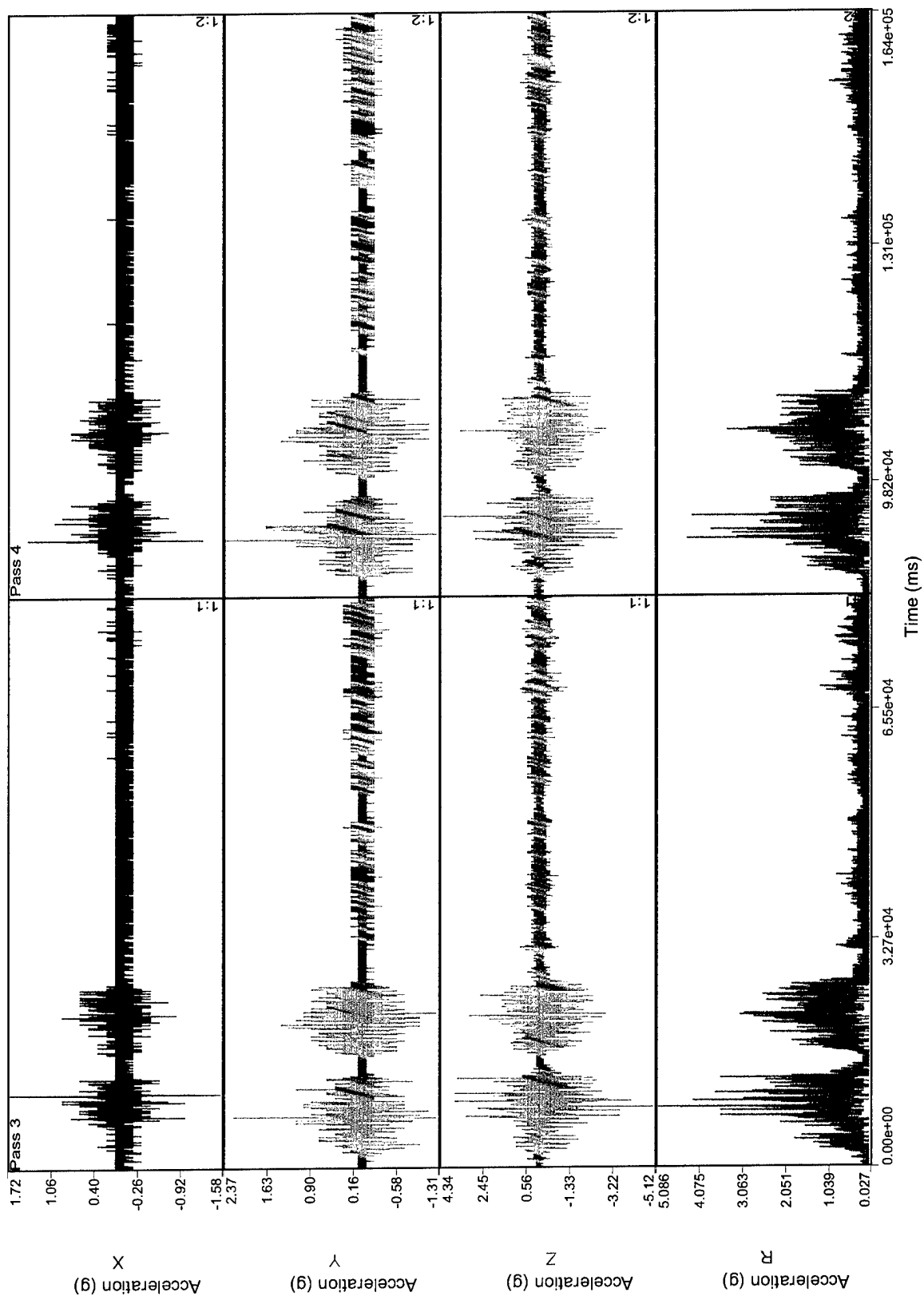
Test Date: 6 Nov 2001

Hazard Course of M871A3 Trailer with 33,940-lb Payload      Sensor Location: Trailer Rear



Test Date: 6 Nov 2001

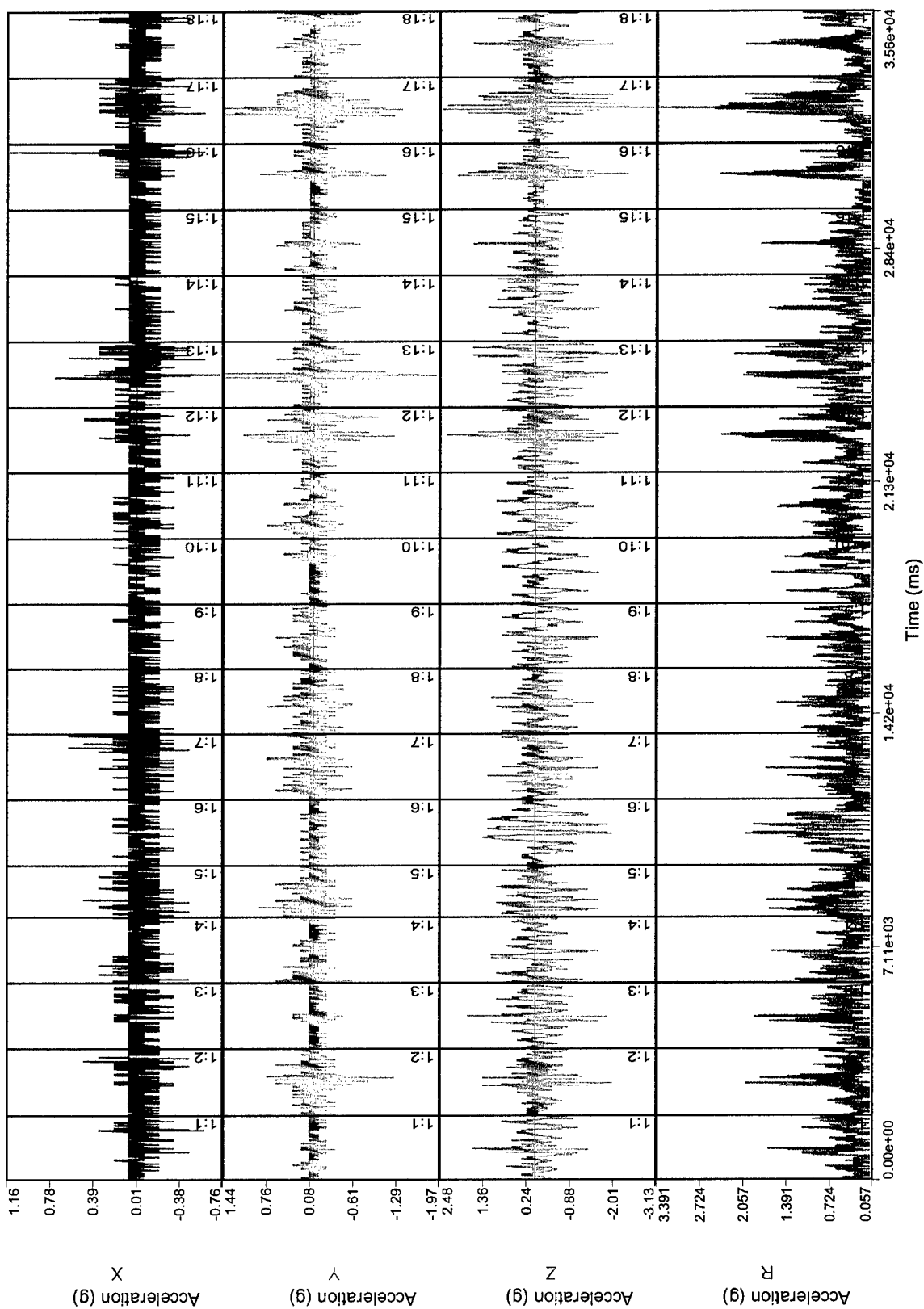
Hazard Course of M871A3 Trailer with 33,940-lb Payload      Sensor Location: Trailer Rear



Test Date: 6 Nov 2001

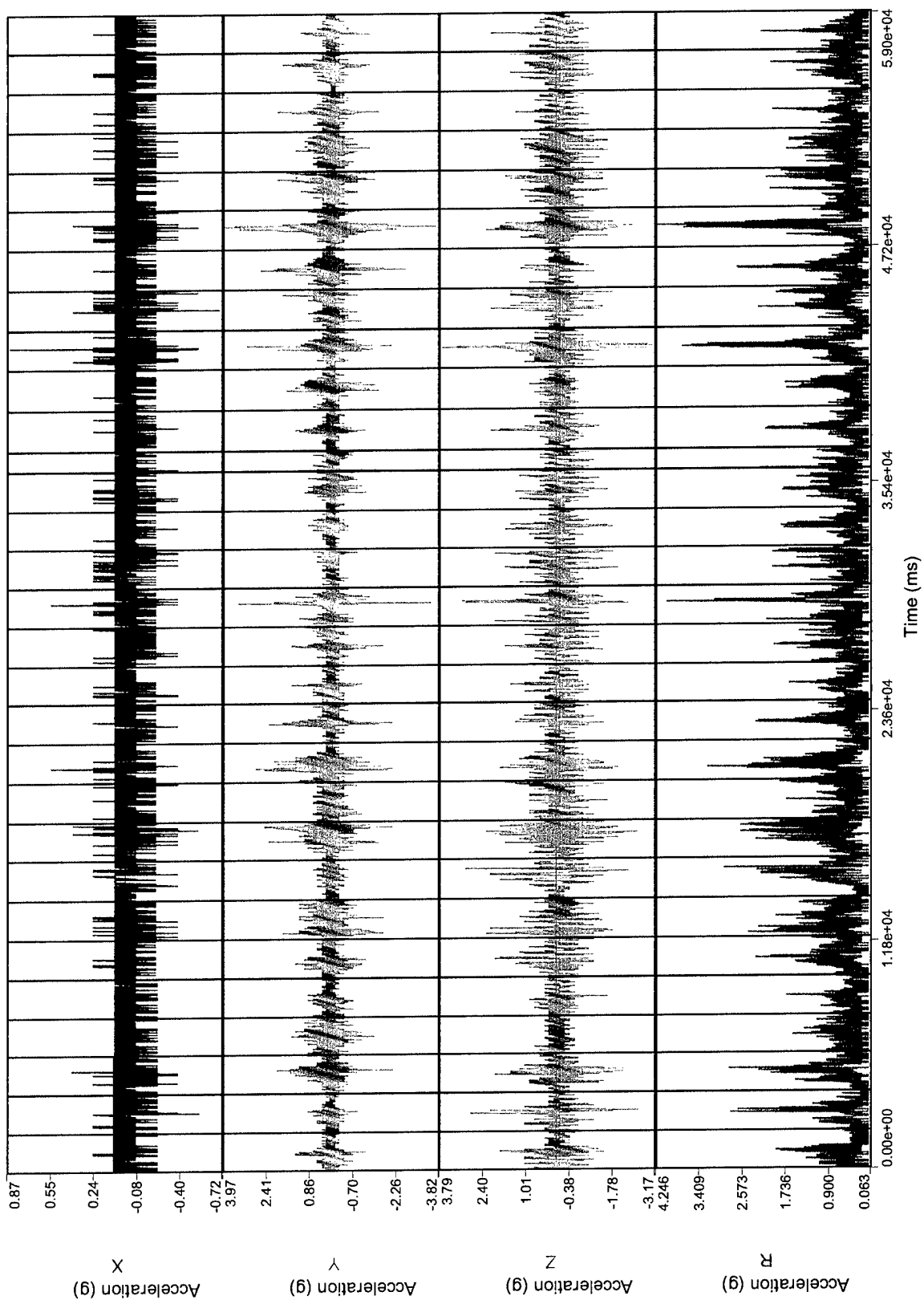
Road Trip of M871A3 Trailer with 33,940-lb Payload

Sensor Location: Trailer Bulkhead



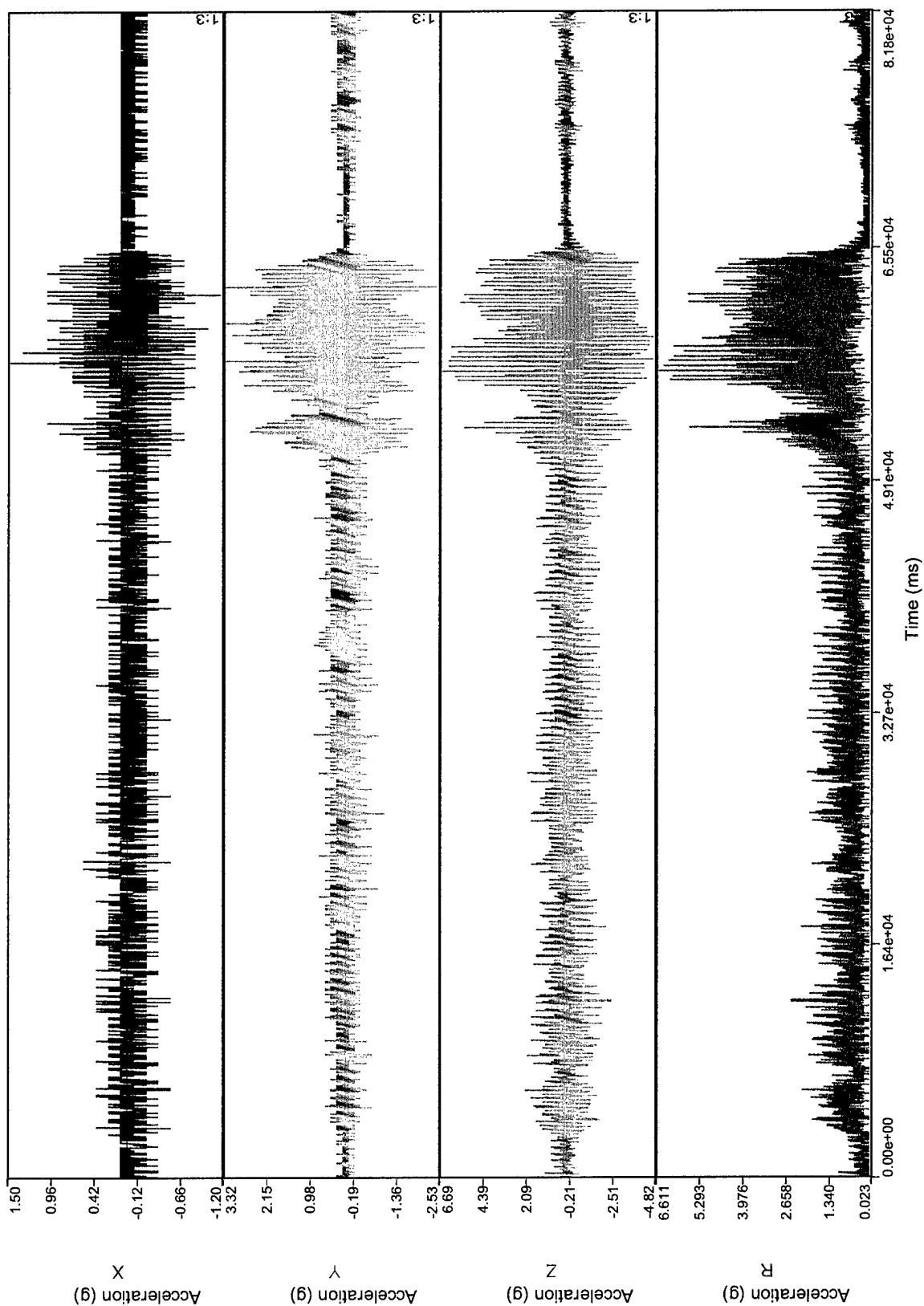
Test Date: 6 Nov 2001

Road Trip of M87/A3 Trailer with 33,940-lb Payload      Sensor Location: Trailer Rear

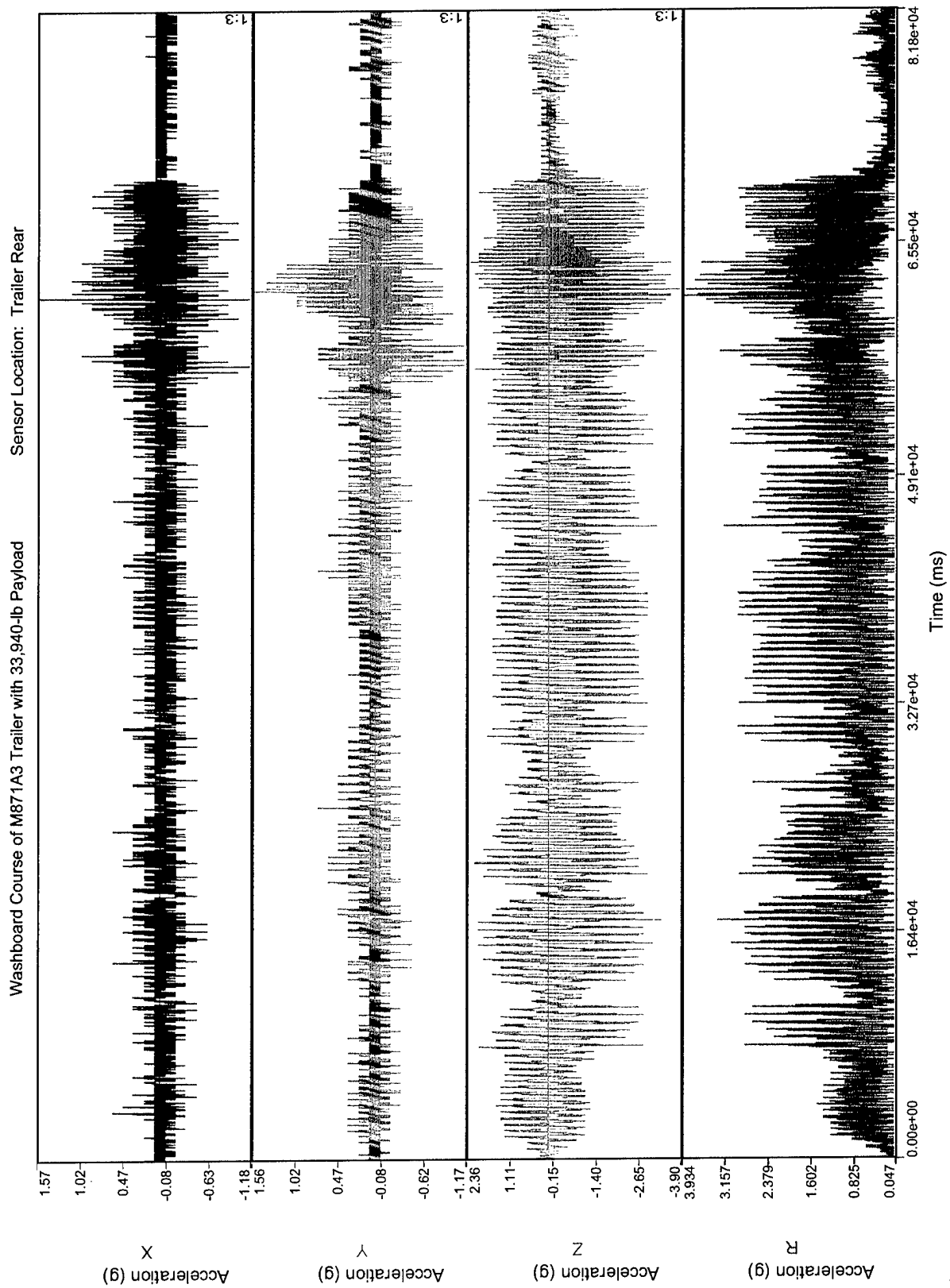


Test Date: 6 Nov 2001

Washboard Course of M871A3 Trailer with 33,940-lb Payload      Sensor Location: Trailer Bulkhead



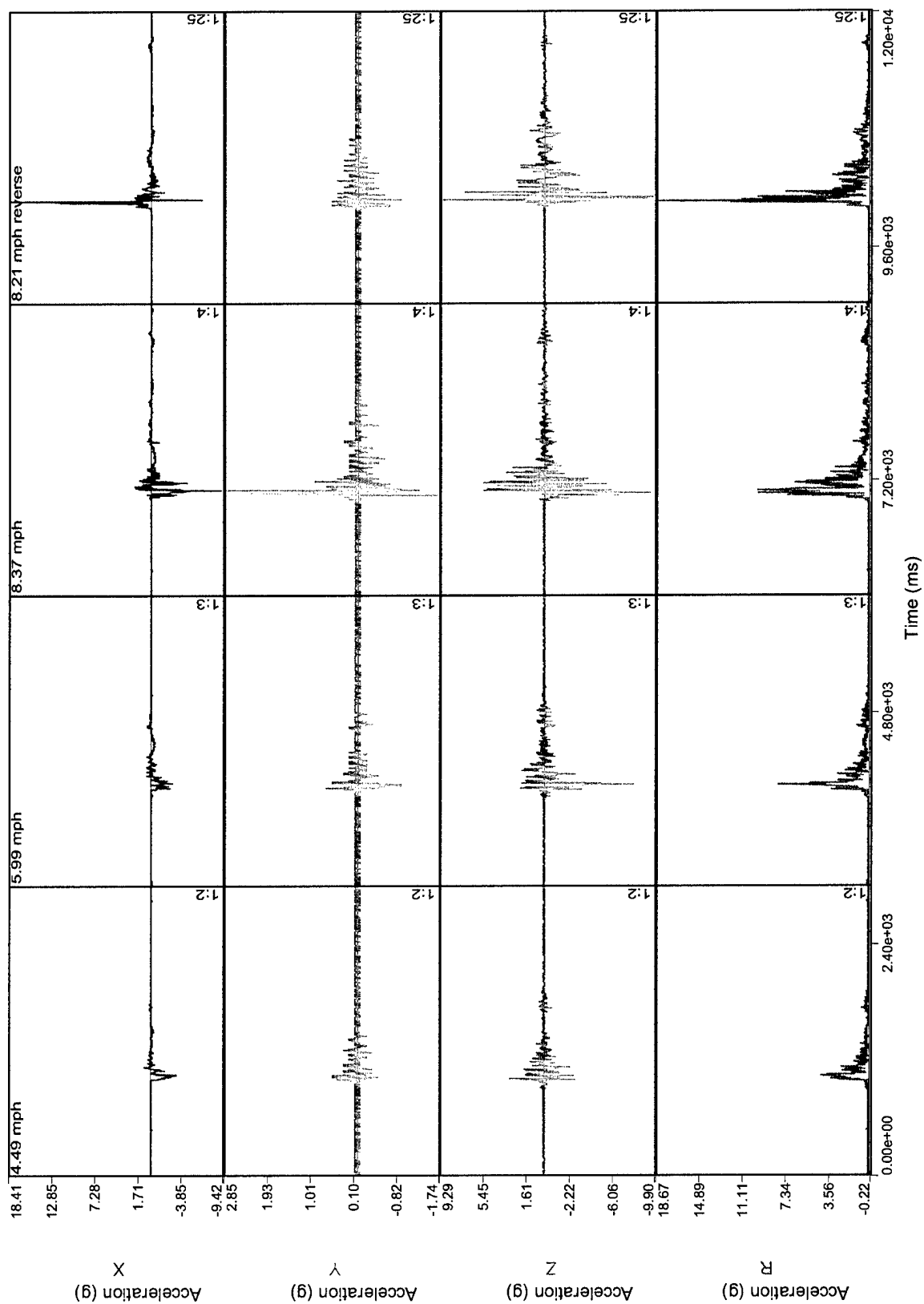
Test Date: 6 Nov 2001



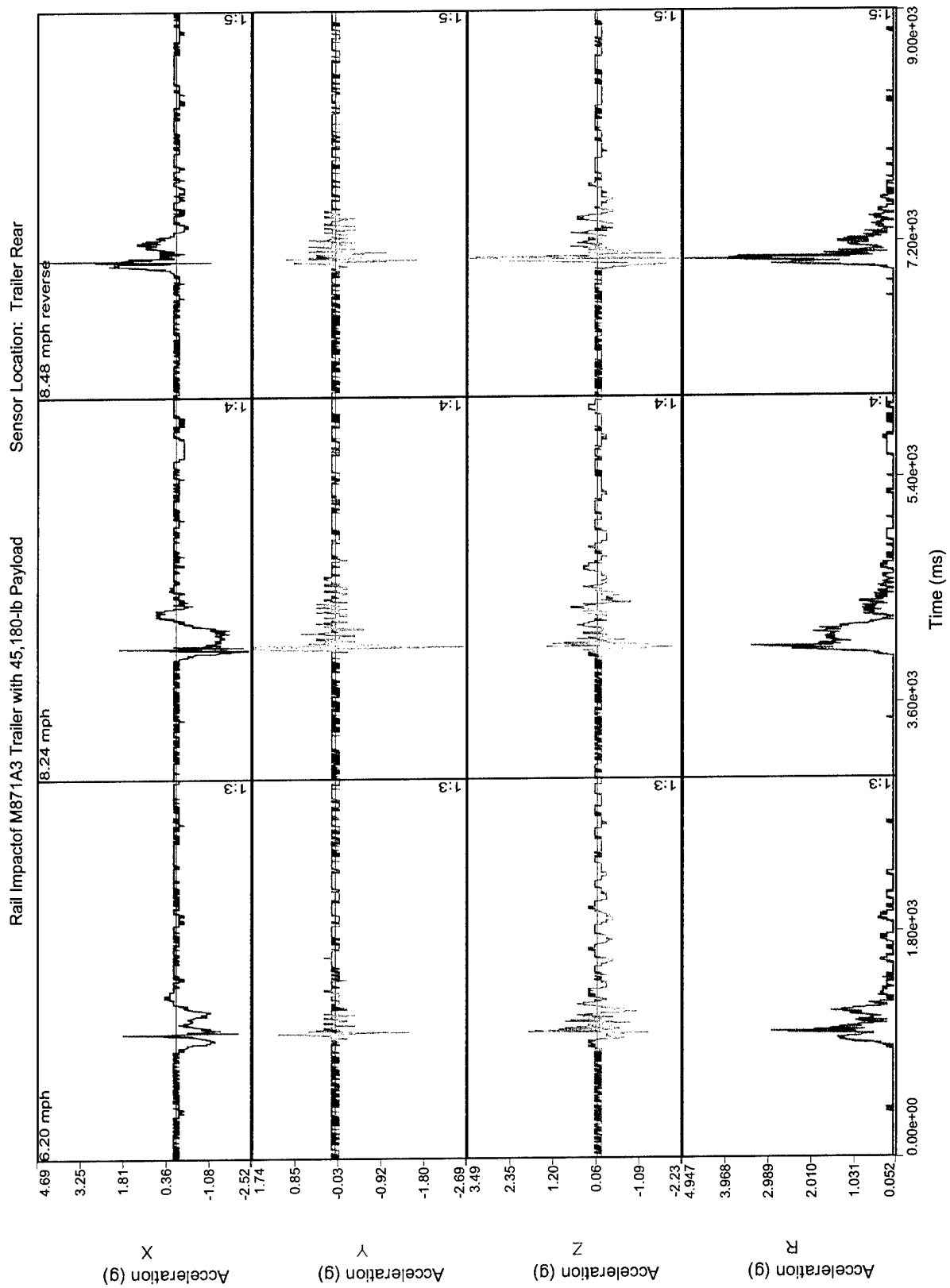
Test Date: 6 Nov 2001



Rail Impact of M871A3 Trailer with 45,180-lb Payload - Sensor Location: Rear Railcar



Test Date: 7 Nov 2001



Test Date: 7 Nov 2001

## **PART 7 – DRAWINGS**

The following excerpts from drawing, DA-106, represents the load configuration that was subjected to the test criteria. The drawing can be obtained by contacting the following office:

Director  
U.S. Army Defense Ammunition Center  
ATTN: SOSAC-DET  
1 C Tree Road  
McAlester, OK 74501-9053

# LOADING, TIEDOWN AND UNLOADING PROCEDURES • FOR CONVENTIONAL AMMUNITION ITEMS, IN/ON TACTICAL VEHICLES, FOR RAPID DEPLOYMENT BY RAIL AND SHIP

## INDEX

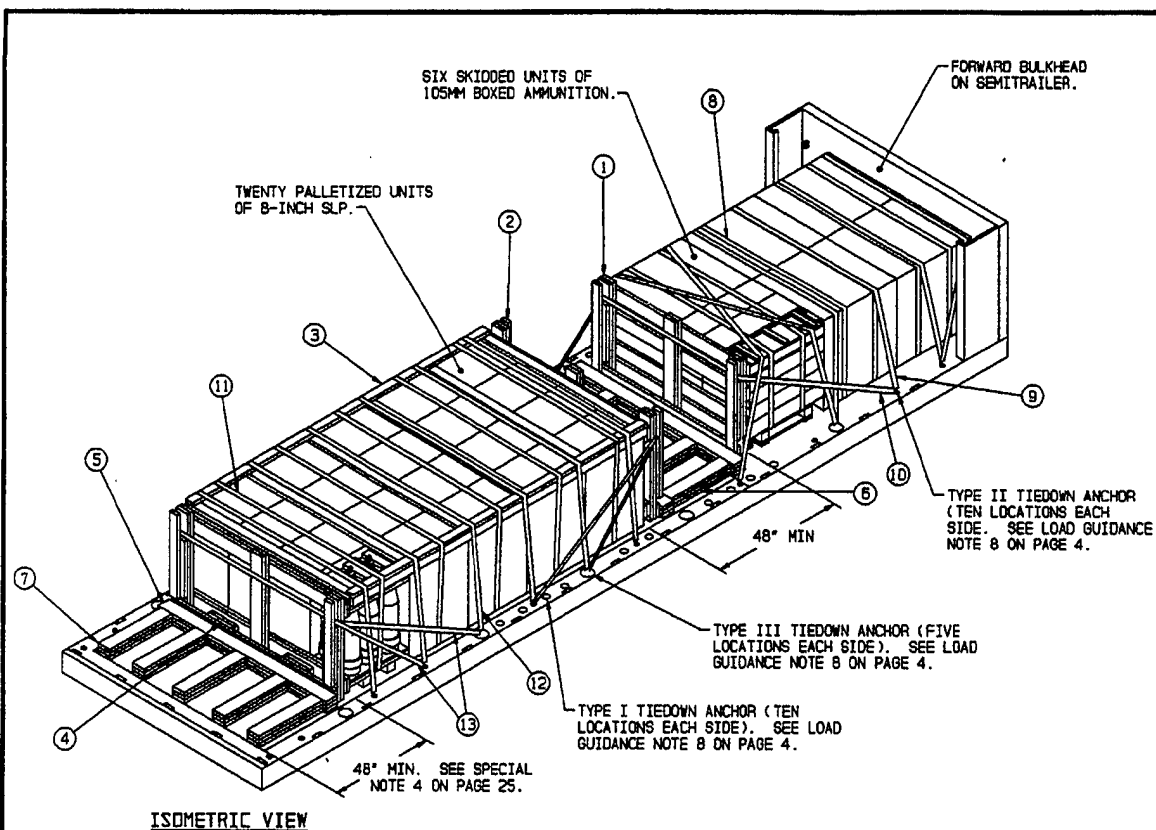
ITEM	PAGE(S)
GENERAL NOTES AND MATERIAL SPECIFICATIONS - - - - -	2
ITEMIZED INDEX, AND LOAD PLANNING GUIDANCE CHART - - - - -	3
LOAD GUIDANCE NOTES - - - - -	4
TYPICAL PALLETIZED/SKIDDED UNIT - - - - -	5
SECUREMENT OF CONVENTIONAL AMMUNITION ITEMS ON TACTICAL VEHICLES - - - - -	6-41
DETAILS - - - - -	42-60

- THE PROCEDURES DEPICTED WITHIN THIS DRAWING ARE FOR TRANSPORTING CONVENTIONAL AMMUNITION LOADED IN/ON TACTICAL VEHICLES, BY RAIL AND/OR SHIP. HOWEVER, THEY MAY ALSO BE USED FOR ON AND/OR OFF HIGHWAY MOVEMENT, IF DESIRED.

DEPARTMENT OF ARMY DRAWING			
	DRAFTSMAN	TECHNICIAN	ENGINEER
	SW. BL. PJB		J. SIMONS
	VALIDATION ENGINEERING DIVISION	TRANSPORTATION ENGINEERING DIVISION	LOGISTICS ENGINEERING OFFICE
	<i>[Signature]</i>	<i>W. Inerick</i>	<i>W. Ernst</i>
MARCH 1992	APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND		
DRAWING NUMBER	<i>John L. Byrd</i>		
DA-106	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL		

DO NOT SCALE

PROJECT DA 7-90



(KEY NUMBERS CONTINUED)

- ⑨ WEB STRAP TIEDOWN ASSEMBLY (6 REQD). INSTALL EACH STRAP TO EXTEND FROM A TIEDOWN ANCHOR ON VEHICLE, OVER TOP OF SKIDDED UNITS, TO A TIEDOWN ANCHOR ON OPPOSITE SIDE OF VEHICLE. POSITION STRAP SCUFF SLEEVES AT SHARP EDGES. TAKE UP EXCESS SLACK IN STRAP AND THEN RATCHET TIGHT. SEE SPECIAL NOTE 9 ON PAGE 25, AND GENERAL NOTES "F", "G" AND "J" ON PAGE 2.
- ⑩ WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL EACH STRAP TO EXTEND FROM A TIEDOWN ANCHOR ON VEHICLE, AROUND THE END OF SKIDDED UNITS BETWEEN THE VERTICAL PIECES AND STRAP RETAINER PIECES OF THE END GATE ASSEMBLY F, TO A TIEDOWN ANCHOR ON OPPOSITE SIDE OF VEHICLE. POSITION STRAP SCUFF SLEEVES AT SHARP EDGES. TAKE UP EXCESS SLACK IN STRAP AND THEN RATCHET TIGHT. SEE SPECIAL NOTE 8 ON PAGE 25, AND GENERAL NOTES "F", "G" AND "H" ON PAGE 2.
- ⑪ WEB STRAP TIEDOWN ASSEMBLY (5 REQD). INSTALL EACH STRAP TO ENCIRCLE FOUR LATERALLY ADJACENT SLP PALLETES AND THE HOLD-DOWN ASSEMBLY C. POSITION STRAP SCUFF SLEEVES AT SHARP EDGES. HOOK ENDS OF STRAP TOGETHER. TAKE UP EXCESS SLACK IN STRAP AND THEN RATCHET TIGHT. SEE GENERAL NOTES "F", "G" AND "H" ON PAGE 2.
- ⑫ WEB STRAP TIEDOWN ASSEMBLY (6 REQD). INSTALL EACH STRAP TO EXTEND FROM A TIEDOWN ANCHOR ON VEHICLE, OVER TOP OF SLP PALLETES AND HOLD-DOWN ASSEMBLY C, TO A TIEDOWN ANCHOR ON OPPOSITE SIDE OF VEHICLE. POSITION STRAP SCUFF SLEEVES AT SHARP EDGES. TAKE UP EXCESS SLACK IN STRAP AND THEN RATCHET TIGHT. SEE GENERAL NOTES "F", "G" AND "H" ON PAGE 2.
- ⑬ WEB STRAP TIEDOWN ASSEMBLY (4 REQD). INSTALL EACH STRAP TO EXTEND FROM A TIEDOWN ANCHOR ON VEHICLE, AROUND THE END OF SLP PALLETES BETWEEN THE VERTICAL PIECES AND STRAP RETAINER PIECES OF THE END GATE ASSEMBLY C, TO A TIEDOWN ANCHOR ON OPPOSITE SIDE OF VEHICLE. POSITION STRAP SCUFF SLEEVES AT SHARP EDGES. TAKE UP EXCESS SLACK IN STRAP AND THEN RATCHET TIGHT. SEE SPECIAL NOTE 8 ON PAGE 25, AND GENERAL NOTES "F", "G" AND "H" ON PAGE 2.

KEY NUMBERS

- ① END GATE ASSEMBLY F (1 REQD). SEE THE DETAIL ON PAGE 47 AND SPECIAL NOTES 10 AND 11 ON PAGE 25.
- ② END GATE ASSEMBLY C (2 REQD). SEE THE DETAIL ON PAGE 46 AND SPECIAL NOTE 11 ON PAGE 25.
- ③ HOLD-DOWN ASSEMBLY C (1 REQD). POSITION AS SHOWN. SEE THE DETAIL ON PAGE 56.
- ④ FILL MATERIAL, 2" X 8" X 12" (DOUBLED) (4 REQD). POSITION BETWEEN THE BOTTOM BEARING PIECE AND THE HORIZONTAL PIECE ON EACH END GATE ASSEMBLY C AND CENTERED ON THE JOINT BETWEEN THE SLP PALLETES. TOENAIL TO THE BEARING PIECE W/2-10d NAILS.
- ⑤ HEADER, 2" X 8" X 80" (TRIPLED) (3 REQD). POSITION THE FIRST PIECE AGAINST THE END GATE ASSEMBLIES AND NAIL TO THE TRAILER FLOOR W/11-12d NAILS. NAIL EACH ADDITIONAL PIECE W/11-20d NAILS.
- ⑥ STRUT, 2" X 6" BY CUT-TO-WEDGE-FIT (TRIPLED) (5 REQD). POSITION ONE STRUT IN LINE WITH THE SLP PALLET EDGE AND ONE CENTERED BETWEEN THE SLP PALLETES. NAIL THE FIRST PIECE TO THE TRAILER FLOOR W/7-12d NAILS. NAIL EACH ADDITIONAL PIECE W/7-20d NAILS. SEE SPECIAL NOTE 12 ON PAGE 25.
- ⑦ BACK-UP CLEAT, 2" X 6" BY CUT-TO-FIT BETWEEN THE HEADER AND THE REAR OF THE TRAILER (TRIPLED) (5 REQD). POSITION ONE CLEAT IN LINE WITH THE SLP PALLET EDGE AND ONE CENTERED BETWEEN THE SLP PALLETES. NAIL THE FIRST PIECE TO THE TRAILER FLOOR W/7-12d NAILS. NAIL EACH ADDITIONAL PIECE W/7-20d NAILS. SEE SPECIAL NOTE 12 ON PAGE 25.
- ⑧ WEB STRAP TIEDOWN ASSEMBLY (6 REQD). INSTALL EACH STRAP TO ENCIRCLE TWO LATERALLY ADJACENT SKIDDED UNITS. POSITION STRAP SCUFF SLEEVES AT SHARP EDGES. HOOK ENDS OF STRAP TOGETHER. TAKE UP EXCESS SLACK IN STRAPS AND RATCHET TIGHT. SEE GENERAL NOTES "F", "G" AND "H" ON PAGE 2.

(CONTINUED AT LEFT)

SIX SKIDDED UNITS OF BOXED AMMUNITION, AND TWENTY PALLET UNITS OF SEPARATE LOADING PROJECTILES ON A 22-1/2-TON M871 SEMITRAILER

PAGE 24

PROJECT DA 7-90

(SPECIAL NOTES CONTINUED)

10. IF THE FORWARD LOAD UNIT IS NOT POSITIONED AGAINST THE FORWARD BULKHEAD, ONE ADDITIONAL END GATE ASSEMBLY MARKED ①, AND ONE ADDITIONAL STRAP MARKED ⑩ WILL BE REQUIRED AT THE FORWARD END. ALSO, A FORWARD BLOCKING ASSEMBLY SIMILAR TO FORWARD BLOCKING ASSEMBLY B ON PAGE 54 MUST BE FABRICATED AND INSTALLED BETWEEN THE FORWARD BULKHEAD ON THE TRAILER AND THE END GATE ASSEMBLY MARKED ①. IF THE SPACE IS 12" OR LESS, SOLID FILL MATERIAL OF 2" X 8" BY INSIDE TRAILER WIDTH, POSITIONED ON EDGE AND LAMINATED TO EACH OTHER, MAY BE USED.
11. WHEN FABRICATING END GATE ASSEMBLIES MARKED ① AND/OR ② THE BOTTOM OF THE STRAP RETAINER PIECES MUST BE 6" ABOVE THE FLOOR TO ALLOW THE HEADER PIECES MARKED ⑤, TO BE POSITIONED TIGHT AGAINST THE HORIZONTAL PIECE ON THE END GATE.
12. WHEN POSITIONING AND NAILING STRUTS MARKED ⑥, AND/OR BACK-UP'S MARKED ⑦, IN TRAILERS HAVING STEEL BOLSTERS IN THE FLOOR, POSITION AS NEAR TO DESIRED LOCATION AS POSSIBLE BUT NOT ON TOP OF STEEL BOLSTERS.
13. A TOTAL OF THIRTY-ONE WEB STRAP TIEDOWN ASSEMBLIES ARE REQUIRED FOR THE LOAD SHOWN. NOTE: EACH WEB STRAP MARKED ⑩ AND ⑪ REQUIRES TWO WEB STRAP TIEDOWN ASSEMBLIES HOOKED TOGETHER.

SPECIAL NOTES:

1. TYPICAL LOAD OF SIX SKIDDED UNITS AND TWENTY PALLETIZED UNITS IS SHOWN LOADED ON A 22-1/2-TON M871 SEMITRAILER HAVING DIMENSIONS OF 96' WIDE BY 354' LONG.
2. THE VEHICLE SHOWN WAS SELECTED AS TYPICAL ONLY, AND VEHICLES OF OTHER DIMENSIONS WHICH HAVE A SUFFICIENT QUANTITY OF TIEDOWN ANCHORS LOCATED ON THE SIDEWALL, ENDWALL AND FLOOR MAY BE USED TO TRANSPORT THE LOAD SHOWN, OR A PARTIAL LOAD.
3. A LOAD OF SIX SKIDDED UNITS OF 105MM BOXED AMMUNITION HAVING DIMENSIONS OF 35-3/8" WIDE BY 34-1/2" LONG BY 36-3/4" HIGH AND WEIGHING 1,955 POUNDS EACH, AND TWENTY PALLETIZED UNITS OF 8-INCH SEPARATE LOADING PROJECTILES HAVING DIMENSIONS OF 28-3/8" WIDE BY 19-1/4" LONG BY 39-1/2" HIGH AND WEIGHING 1,253 POUNDS EACH ARE SHOWN AS A TYPICAL LOAD. IF LOADING PALLETIZED UNITS AND/OR SKIDDED UNITS OF OTHER ITEMS, QUANTITIES, DIMENSIONS AND WEIGHTS FOLLOW THESE SAME PROCEDURES.
4. CAUTION: THE MAXIMUM WEIGHT THAT CAN BE SECURED USING THE PROCEDURES SHOWN ON PAGE 24 IS 25,500 POUNDS. THEREFORE A LOAD WEIGHING MORE THAN 25,500 POUNDS, UP TO A MAXIMUM LOAD WEIGHING 45,000 POUNDS, MUST BE DIVIDED INTO TWO SEPARATE LOAD UNITS. A LOAD UNIT WEIGHING 12,000 POUNDS OR LESS ONLY REQUIRES ONE STRAP MARKED ⑩ FOR LONGITUDINAL RESTRAINT AT THE TOP. A LOAD UNIT WEIGHING OVER 12,000 POUNDS UP TO 25,100 POUNDS, REQUIRES TWO STRAPS MARKED ⑩ AT EACH END OF THE LOAD FOR LONGITUDINAL RESTRAINT AT THE TOP. A MINIMUM SPACE OF 48" MUST BE MAINTAINED BETWEEN LOAD UNITS, AND BETWEEN THE REAR OF THE LOAD AND THE AFT END OF THE VEHICLE. NOTE THAT THE TOTAL WEIGHT OF THE LOAD SHOWN ON PAGE 24 IS 37,563 AND THEREFOR THE LOAD WAS DIVIDED INTO TWO LOAD UNITS.
5. PRIOR TO LOADING VEHICLE DETERMINE THE TOTAL QUANTITY OF PALLETIZED AND/OR SKIDDED UNITS TO BE LOADED. IF THE TOTAL LOAD WEIGHT IS GREATER THAN 25,500 POUNDS, THE LOAD MUST BE DIVIDED INTO TWO LOAD UNITS AS INSTRUCTED IN SPECIAL NOTE 4 ABOVE. DETERMINE WHAT ITEMS ARE TO BE GROUPED TOGETHER, HOW MANY ACROSS VEHICLE WIDTH, HOW MANY LONG AND THE TOTAL WEIGHT OF EACH LOAD UNIT. FOR EASE OF LOADING AND SECUREMENT OF LOAD EACH ROW OF PALLETIZED SEPARATE LOADING PROJECTILES POSITIONED ACROSS THE VEHICLE WIDTH MUST CONTAIN THE SAME QUANTITY. USE AN "OMITTED SLP PALLETIZED UNIT ASSEMBLY A", AS SHOWN IN THE LOAD ON PAGE 16. FOR EACH OMITTED SLP PALLETIZED UNIT AS NECESSARY TO MAINTAIN EVEN ROWS. SELECT A LOCATION WITHIN THE VEHICLE LENGTH WHICH WILL ALLOW STRAPPING PROCEDURES, AS SHOWN IN THE LOAD ON PAGE 24, TO BE APPLIED TO EACH LOAD UNIT.
6. IF THE VEHICLE BEING LOADED IS NOT EQUIPPED WITH TIEDOWN ANCHORS, OR FOR AN ALTERNATIVE METHOD OF SECURING THE LOAD USING STEEL STRAPPING IN LIEU OF WEB STRAPS, USE THE PROCEDURES SHOWN IN THE LOAD ON PAGES 26 AND 27.
7. LOAD UNITS WEIGHING OVER 12,000 POUNDS WILL REQUIRE TWO STRAPS MARKED ⑩ AT EACH END OF THE LOAD. INSTALL THE LONGER STRAPS FIRST AT EACH END OF THE LOAD UNIT AND RATCHET TIGHT BOTH STRAPS AT THE SAME TIME. INSTALL THE SHORTER STRAPS OVER TOP OF THE LONG STRAP AT EACH END OF THE LOAD UNIT AND RATCHET TIGHT BOTH STRAPS AT THE SAME TIME.
8. POSITION THE LONGER STRAPS MARKED ⑩ AND ⑪ AT AN APPROXIMATE ANGLE OF 30° WITH THE FLOOR. POSITION THE SHORTER STRAPS MARKED ⑬ AT AN APPROXIMATE ANGLE OF 45° WITH THE FLOOR.
9. IF THE LOCATION OF THE TIEDOWN ANCHORS ON THE FLOOR OF THE VEHICLE DOES NOT ALLOW STRAPS MARKED ⑨ OR ⑫ TO BE POSITIONED STRAIGHT OVER TOP OF LOAD, THEY MAY BE CROSSED AS SHOWN OVER TOP OF THE REARMOST SKIDDED UNITS IN THE LOAD ON PAGE 24.

(CONTINUED AT LEFT)

LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (APPROX)
8-INCH SLP	20	25,060 LBS
105MM CARTRIDGES	6	11,730 LBS
DUNNAGE		773 LBS
TOTAL WEIGHT		37,563 LBS (APPROX)

BILL OF MATERIAL		
LUMBER	LINEAR FEET	BOARD FEET
2" X 2"	19	6
2" X 4"	101	67
2" X 6"	310	310
NAILS	NO. REQD	POUNDS
10d (3")	338	5-1/4
12d (3-1/4")	25	1/2
20d (4")	50	1/2

SIX SKIDDED UNITS OF BOXED AMMUNITION, AND TWENTY PALLET UNITS OF SEPARATE  
LOADING PROJECTILES ON A 22-1/2-TON M871 SEMITRAILER

PAGE 25

PROJECT DA 7-90